US011690455B2

(12) **United States Patent**
Smith et al.

(10) **Patent No.: US 11,690,455 B2**
(45) **Date of Patent: Jul. 4, 2023**

(54) **SYNCHRONOUS-TILT RECLINING CHAIR**

(71) Applicant: **Dinkar Chellaram**, Bangalore (IN)

(72) Inventors: **Shaun Smith**, Harleysville, PA (US); **John Chierici**, Philadelphia, PA (US); **Jeff Theesfeld**, Schwenksville, PA (US)

(73) Assignee: **Dinkar Chellaram**, Bangalore (IN)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/478,897**

(22) Filed: **Sep. 18, 2021**

(65) **Prior Publication Data**

US 2022/0087425 A1 Mar. 24, 2022

Related U.S. Application Data

(60) Provisional application No. 63/080,364, filed on Sep. 18, 2020.

(51) **Int. Cl.**
A47C 1/031 (2006.01)
A47C 1/032 (2006.01)

(52) **U.S. Cl.**
CPC ***A47C 1/03261*** (2013.01); ***A47C 1/03272*** (2013.01); *A47C 1/031* (2013.01); *A47C 1/032* (2013.01)

(58) **Field of Classification Search**
CPC A47C 1/03261; A47C 1/03272
USPC 297/300.2, 300.5, 316, 340, 341, 342
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,270,797 A * 6/1981 Brauning A47C 1/03283 297/316
4,653,806 A * 3/1987 Willi .... A47C 1/03266 297/300.5 X
4,685,730 A * 8/1987 Linguanotto A47C 1/03255 297/316
4,709,963 A * 12/1987 Uecker A47C 1/03266 297/316
4,840,426 A * 6/1989 Vogtherr .... A47C 1/03255 297/300.5 X
4,848,837 A * 7/1989 Volkle A47C 1/0325 297/316
4,877,291 A * 10/1989 Taylor .... A47C 1/03283 297/300.3 X

(Continued)

FOREIGN PATENT DOCUMENTS

CN 103479112 A * 1/2014 .... A47C 1/03255
CN 103504845 A * 1/2014 .... A47C 1/03255

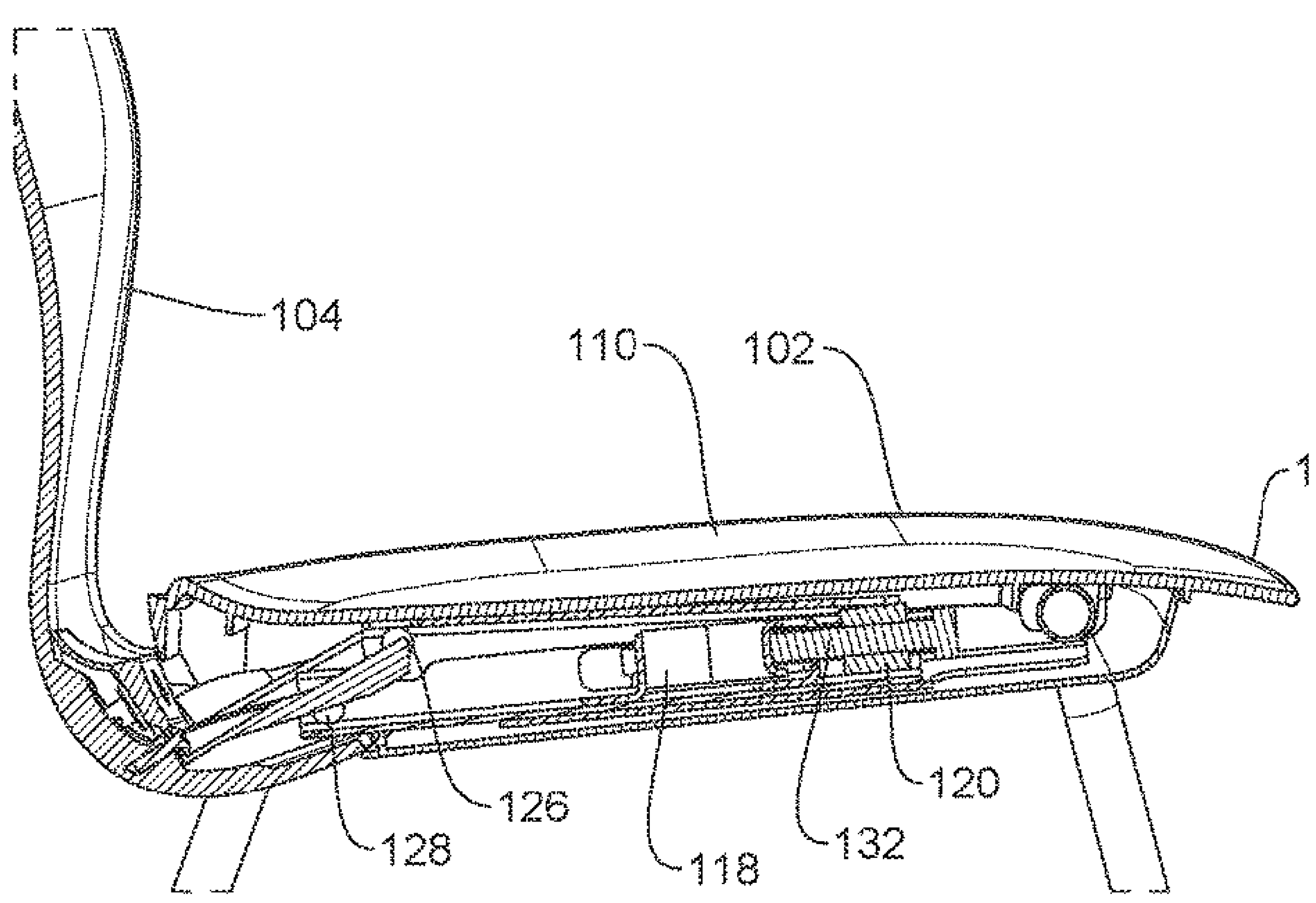
(Continued)

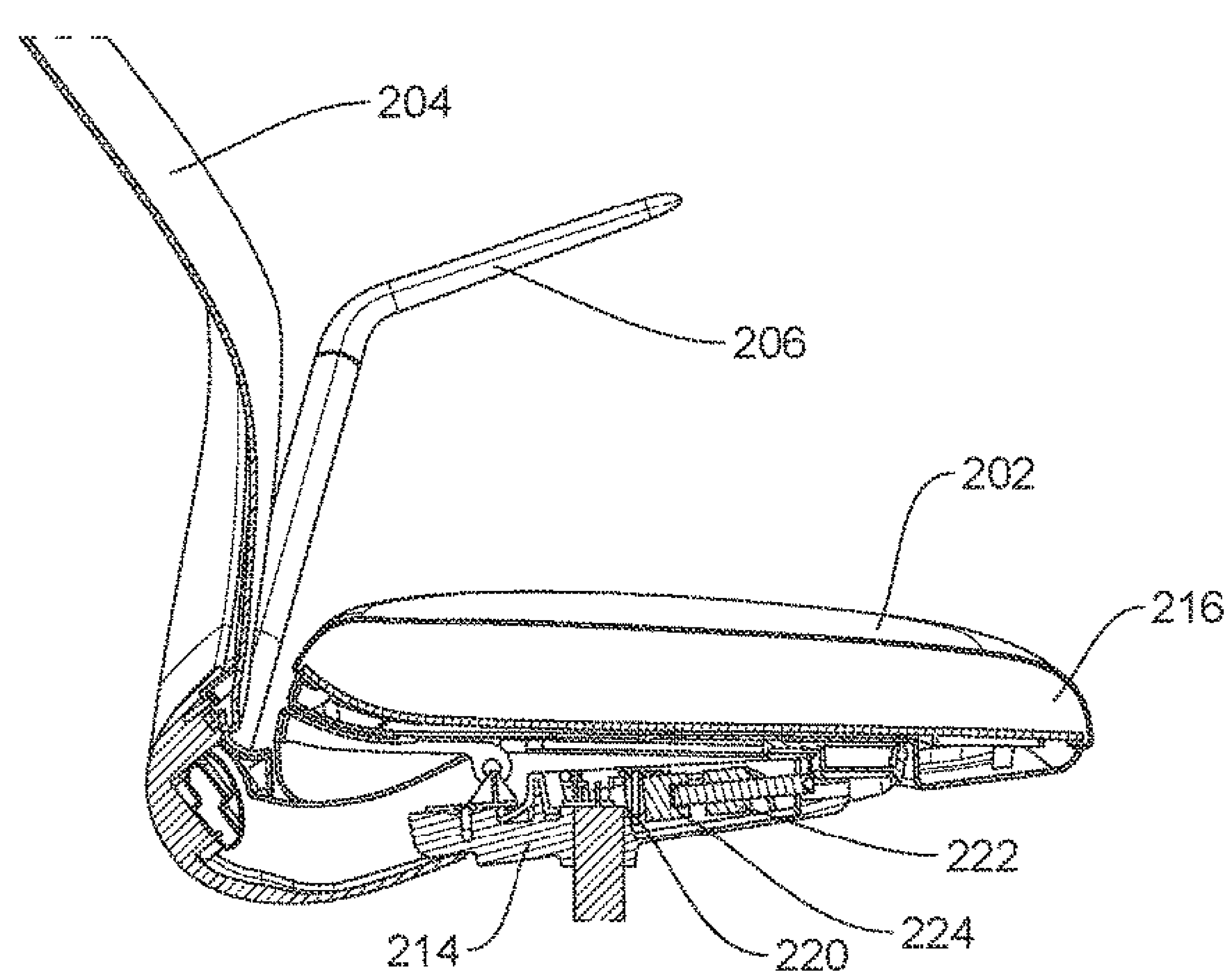
Primary Examiner — Rodney B White
(74) *Attorney, Agent, or Firm* — Howson & Howson LLP

(57) **ABSTRACT**

A synchronous-tilt reclining office chair includes a seat, a backrest interconnected to the seat, and an arrangement providing a synchronous-tilt mechanism that controls synchronous movement of the backrest and seat between a normal non-reclined position and a reclined position. Recline tension provided by the arrangement is a function of a force required to compress at least one tensioning spring mounted below the seat, a weight applied on the seat by a seat occupant, and a location of the weight on the seat relative to front and rear portions of the seat, whereby, as the weight is applied toward the front portion of the seat, recline tension is reduced and, as the weight is applied toward the rear portion of the seat, recline tension is increased.

14 Claims, 12 Drawing Sheets





(56) **References Cited**

U.S. PATENT DOCUMENTS

4,966,411	A *	10/1990	Katagiri	A47C 31/126 297/300.5 X
5,026,117	A *	6/1991	Faiks	A47C 7/441 297/300.5 X
5,106,157	A *	4/1992	Nagelkirk	A47C 1/03255 297/300.5 X
5,160,184	A *	11/1992	Faiks	A47C 3/026 297/300.5 X
5,251,958	A *	10/1993	Roericht	A47C 31/126 297/321
5,354,120	A *	10/1994	Volkle	A47C 1/03255 297/342 X
5,366,274	A *	11/1994	Roericht	A47C 1/03255 297/300.2 X
5,486,035	A *	1/1996	Koepke	A47C 1/03255 297/340
5,582,459	A	12/1996	Hama et al.	
5,601,336	A *	2/1997	Troyas-Bermejo	A47C 1/03272 297/316
5,660,439	A *	8/1997	Unwalla	A47C 1/03255 297/300.5 X
6,027,169	A *	2/2000	Roslund, Jr.	A47C 1/03261 297/341 X
6,109,694	A *	8/2000	Kurtz	A47C 1/03255 297/300.2 X
6,394,549	B1 *	5/2002	DeKraker	A47C 7/24 297/342 X
6,609,755	B2 *	8/2003	Koepke	A47C 7/282 297/300.2 X
6,685,267	B1 *	2/2004	Johnson	A47C 1/03238 297/316
6,709,058	B1 *	3/2004	Diffrient	A47C 31/126 297/316
6,886,888	B2	5/2005	Bock	
6,890,030	B2 *	5/2005	Wilkerson	A47C 1/023 297/316
6,923,503	B2 *	8/2005	Sangiorgio	A47C 1/03255 297/342 X
7,114,777	B2	10/2006	Knoblock et al.	
7,467,826	B1 *	12/2008	Wen	A47C 1/03294 297/300.8 X
7,497,515	B2 *	3/2009	Krehm	A47C 7/443 297/300.5 X
7,530,637	B1 *	5/2009	Wu	A47C 1/03266 297/300.5 X
7,717,515	B2 *	5/2010	Saez	A47C 1/032 297/316
7,798,573	B2	9/2010	Pennington et al.	
7,837,265	B2	11/2010	Machael et al.	
7,992,937	B2 *	8/2011	Plikat	A47C 31/126 297/316
8,272,692	B1 *	9/2012	Epperson	A47C 1/03283 297/300.2 X
8,899,681	B2 *	12/2014	Ko	A47C 1/03294 297/340 X
8,944,507	B2	2/2015	Goetz	
9,414,684	B2	8/2016	Park et al.	
9,521,907	B2	12/2016	Romero	
9,585,479	B2	3/2017	Keilhauer et al.	
9,801,471	B2	10/2017	Machael et al.	
9,974,389	B2	5/2018	Sander et al.	
10,362,874	B2	7/2019	Walker et al.	
10,383,445	B2	8/2019	Serber	
10,433,642	B2	10/2019	Schneider	
10,610,019	B2	4/2020	Bock	
2003/0184140	A1 *	10/2003	Bruske	A47C 1/03255 297/316
2005/0275265	A1 *	12/2005	Deimen	A47C 1/03255 297/316
2008/0272638	A1 *	11/2008	Bock	A47C 1/03272 297/316
2011/0074197	A1 *	3/2011	Okamoto	A47C 1/03272 297/300.6 X
2011/0304192	A1	12/2011	Augustat	
2012/0025574	A1 *	2/2012	Wilkinson	A47C 7/14 297/316 X
2015/0102648	A1 *	4/2015	Park	A47C 1/03277 297/340
2015/0245713	A1 *	9/2015	Desanta	A47C 7/44 297/316
2015/0342353	A1 *	12/2015	Keilhauer	A47C 1/03255 297/316
2020/0085194	A1 *	3/2020	Maier	A47C 1/03261

FOREIGN PATENT DOCUMENTS

CN	104223821	A *	12/2014	A47C 1/03255
CN	204181246	U *	3/2015	A47C 1/03255
CN	111387745	A *	7/2020	A47C 1/03238
EP	2926690	A1 *	10/2015	A47C 1/03211
EP	3649893	A1 *	5/2020	A47C 1/03272
WO	WO-2008020824	A2 *	2/2008	A47C 1/03255

* cited by examiner

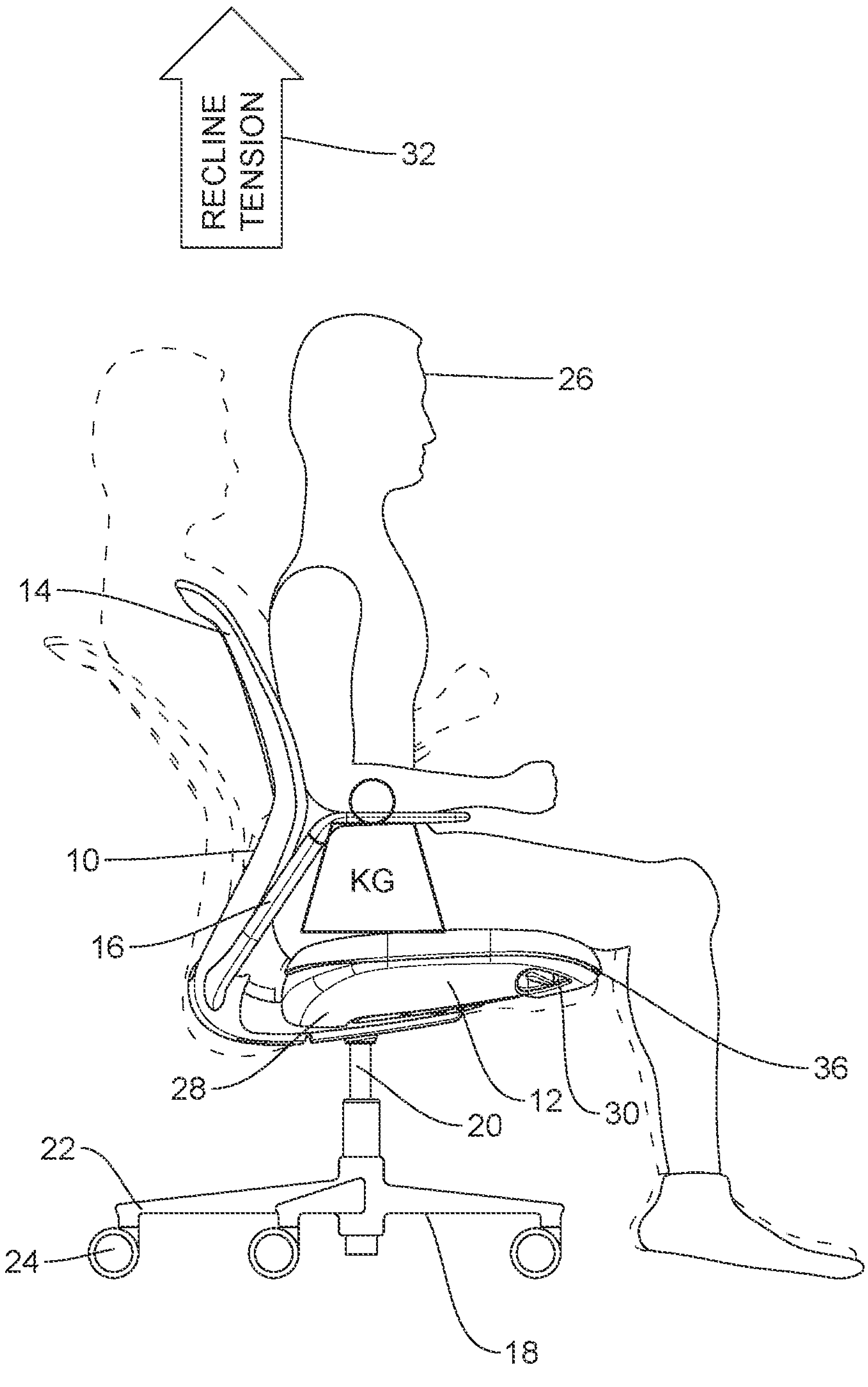


FIG. 1

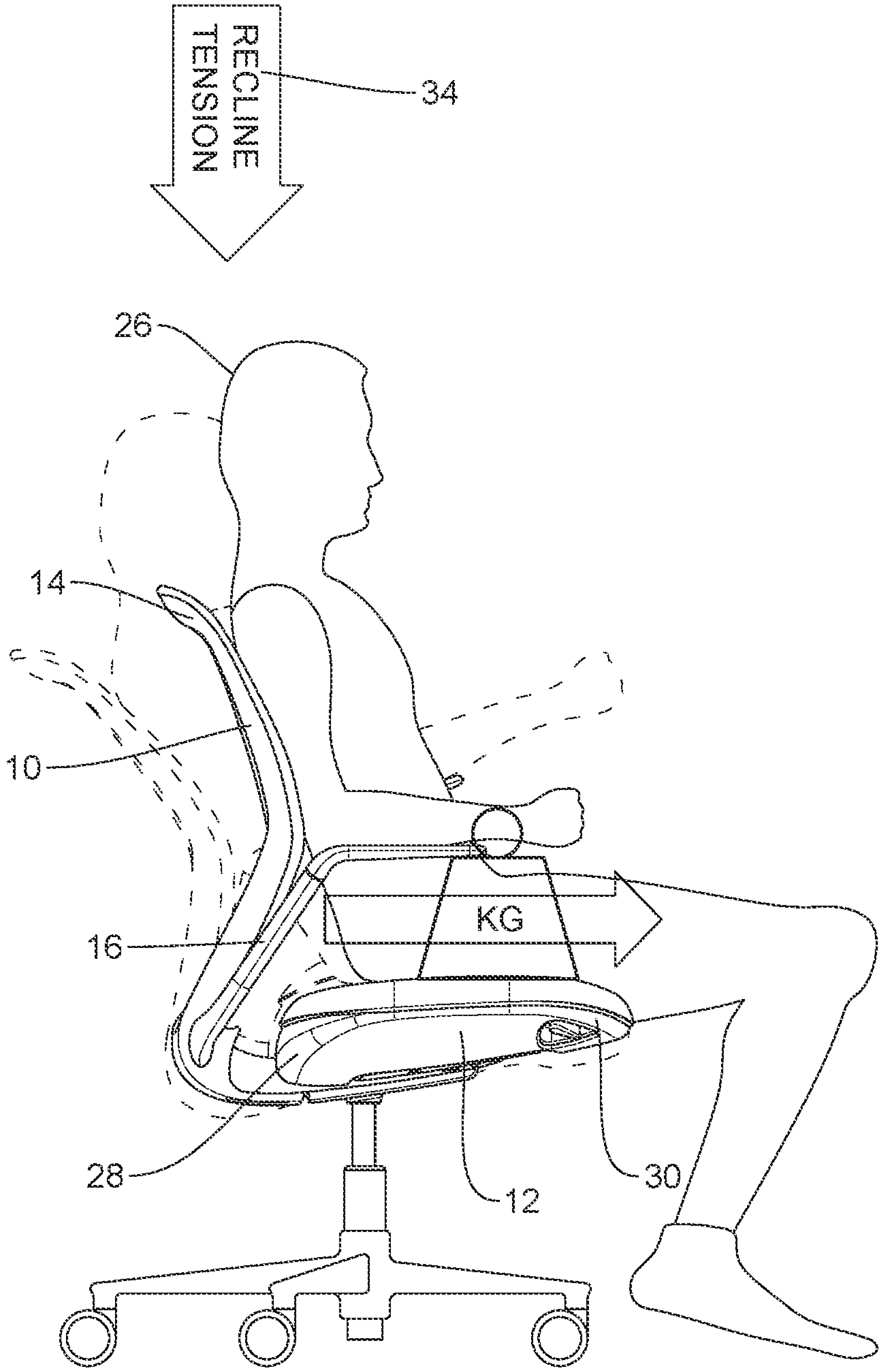


FIG. 2

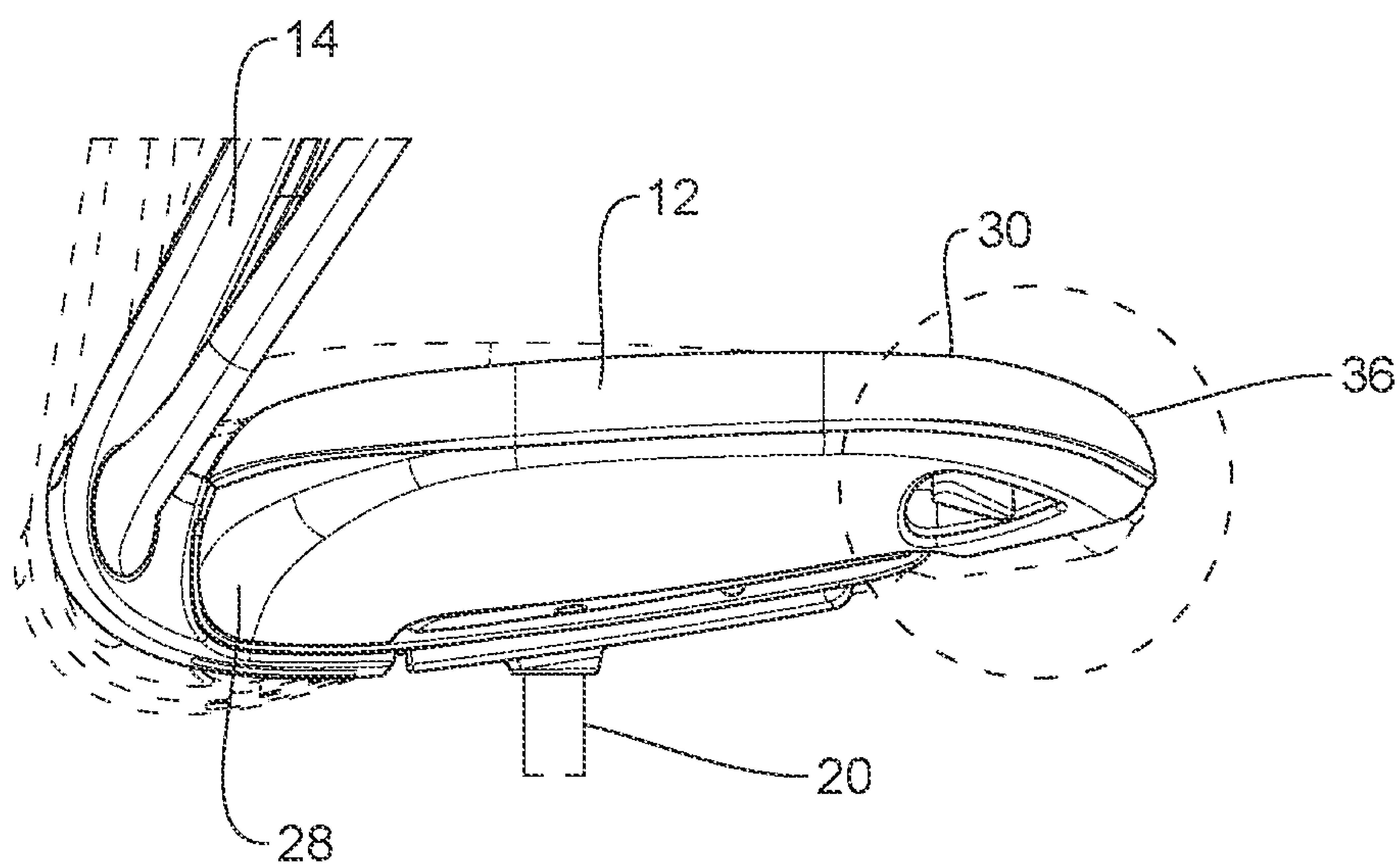


FIG. 3

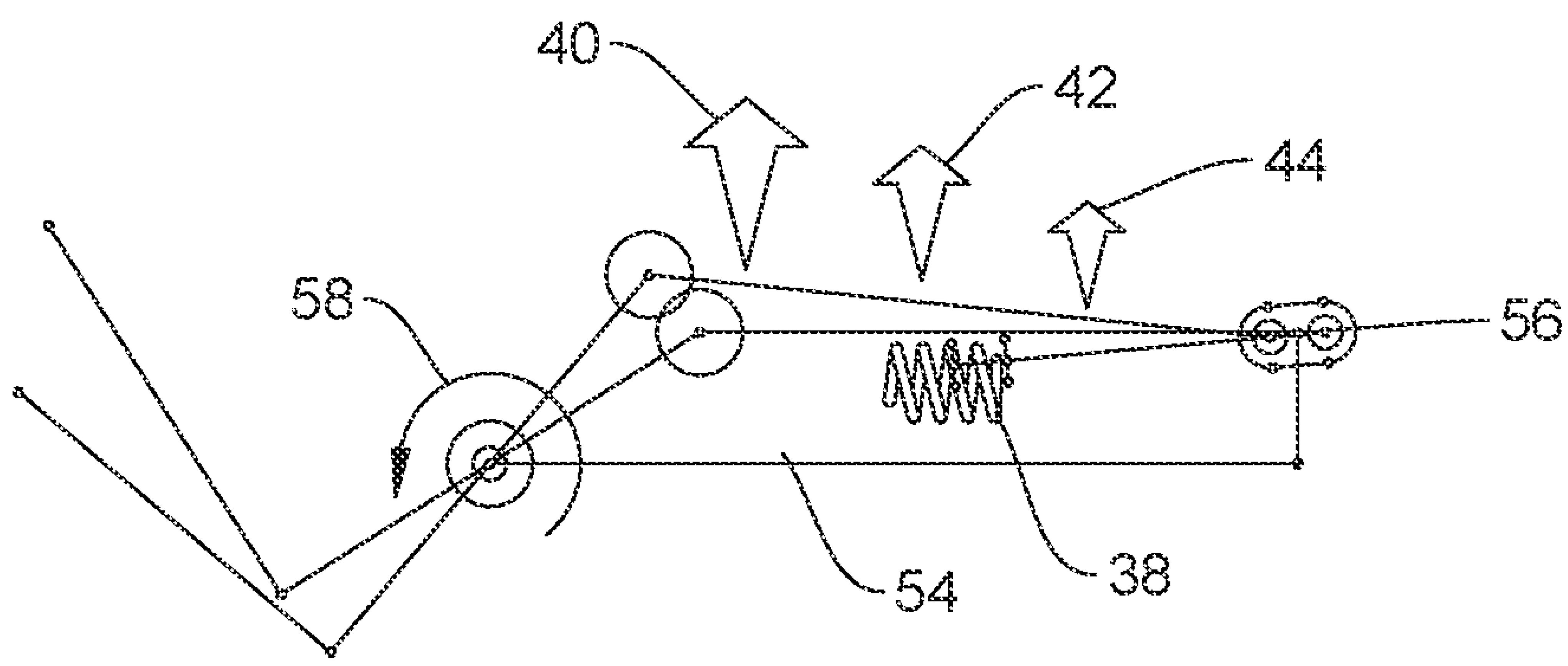


FIG. 4

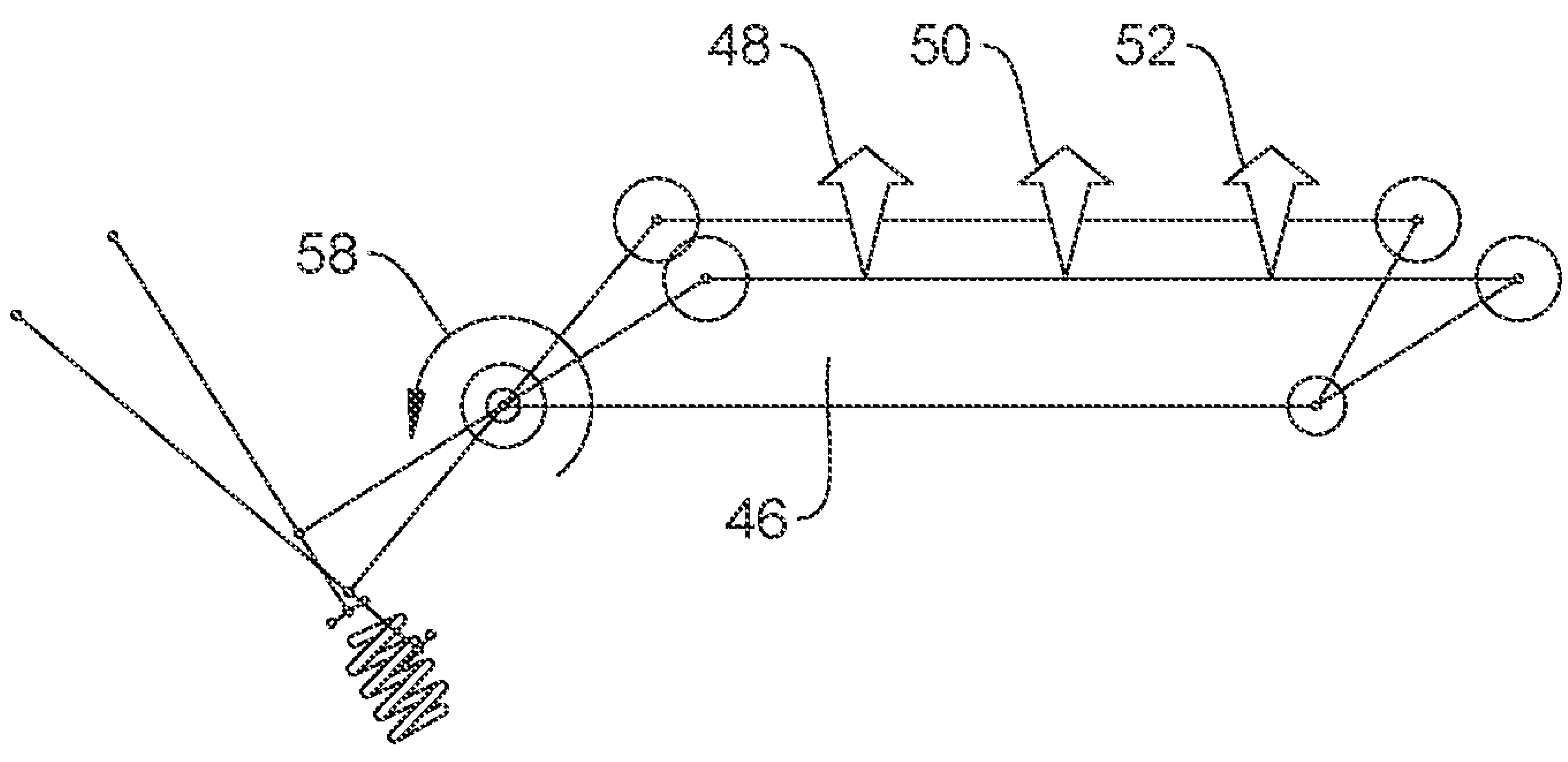


FIG. 5

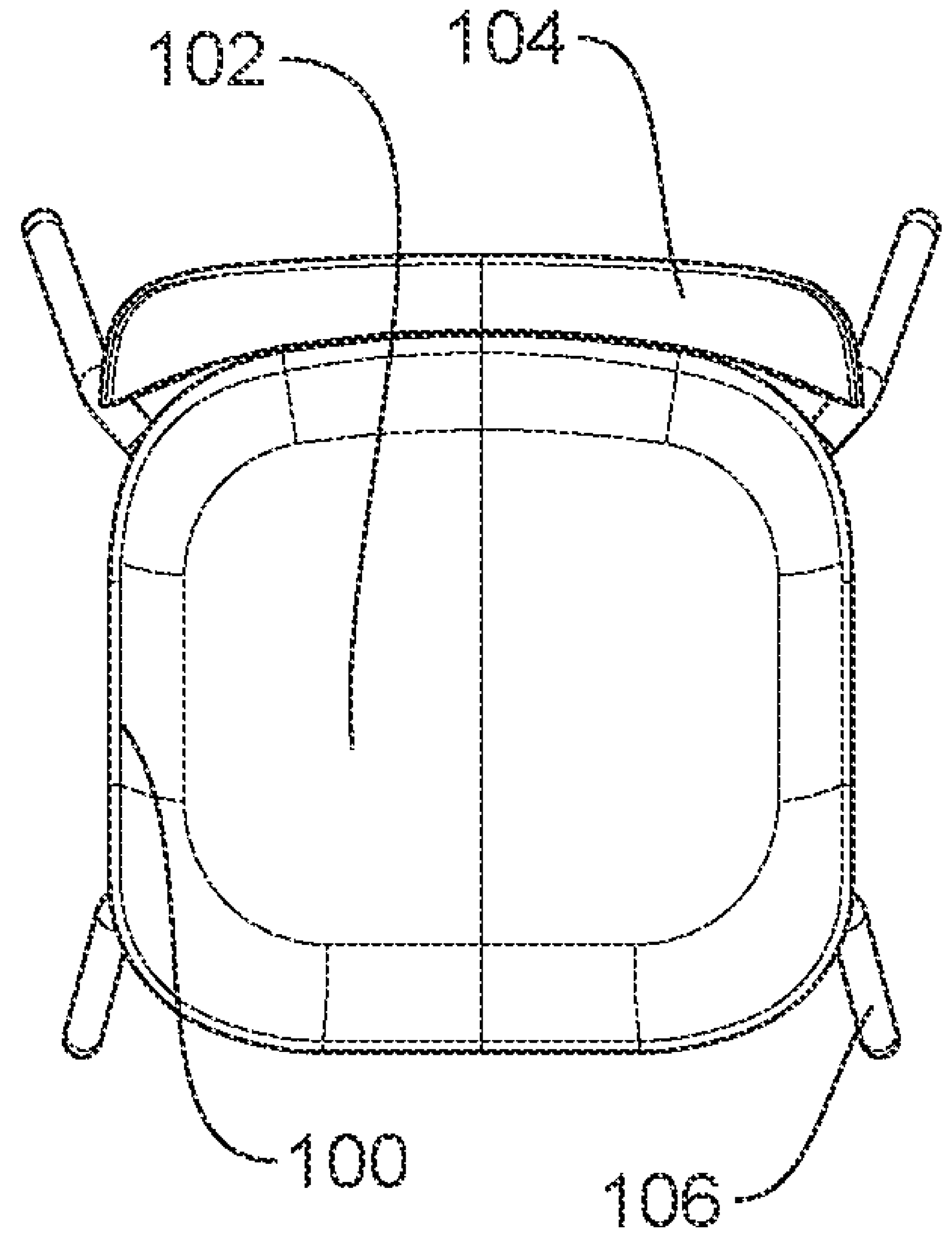


FIG. 6A

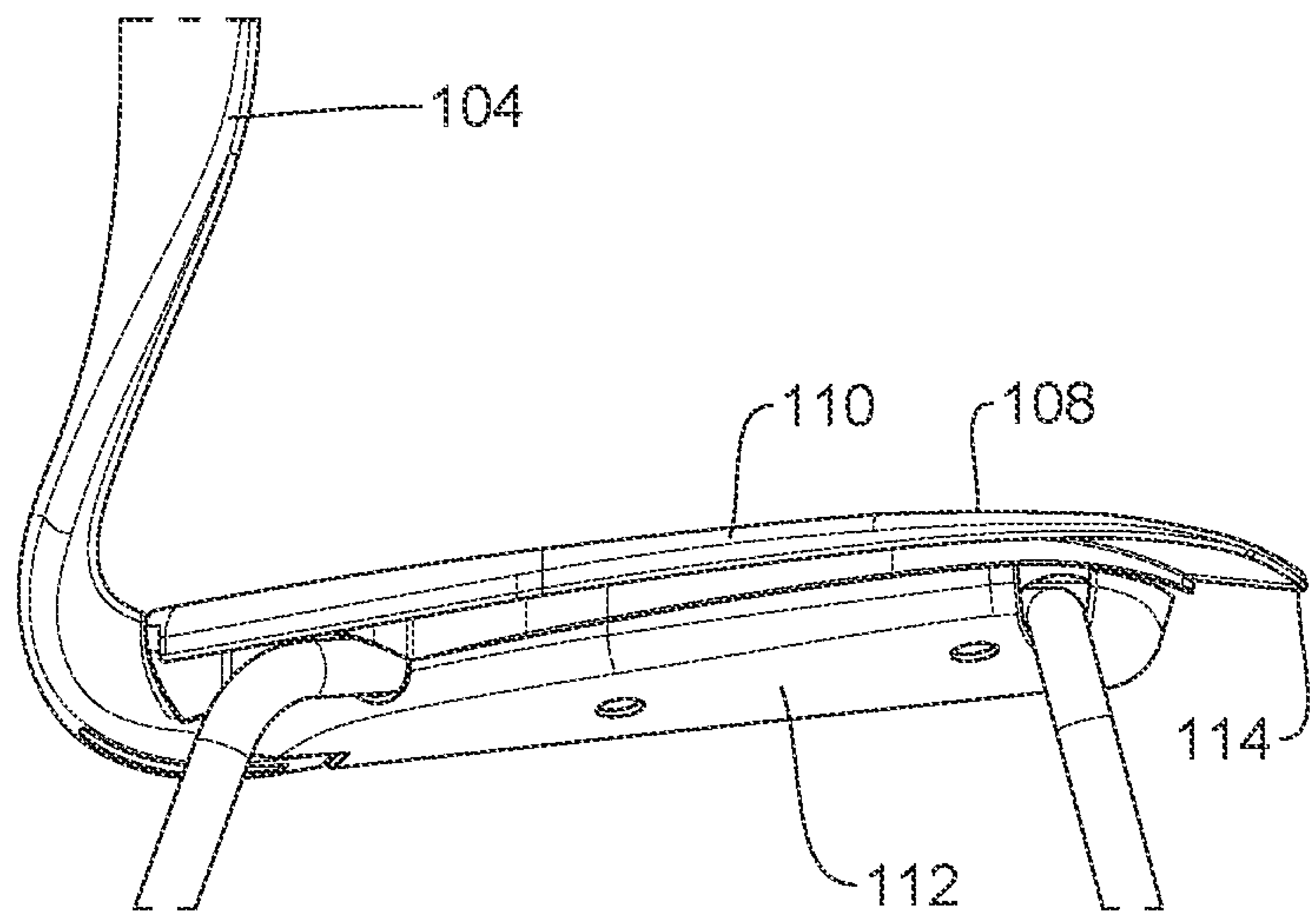


FIG. 6B

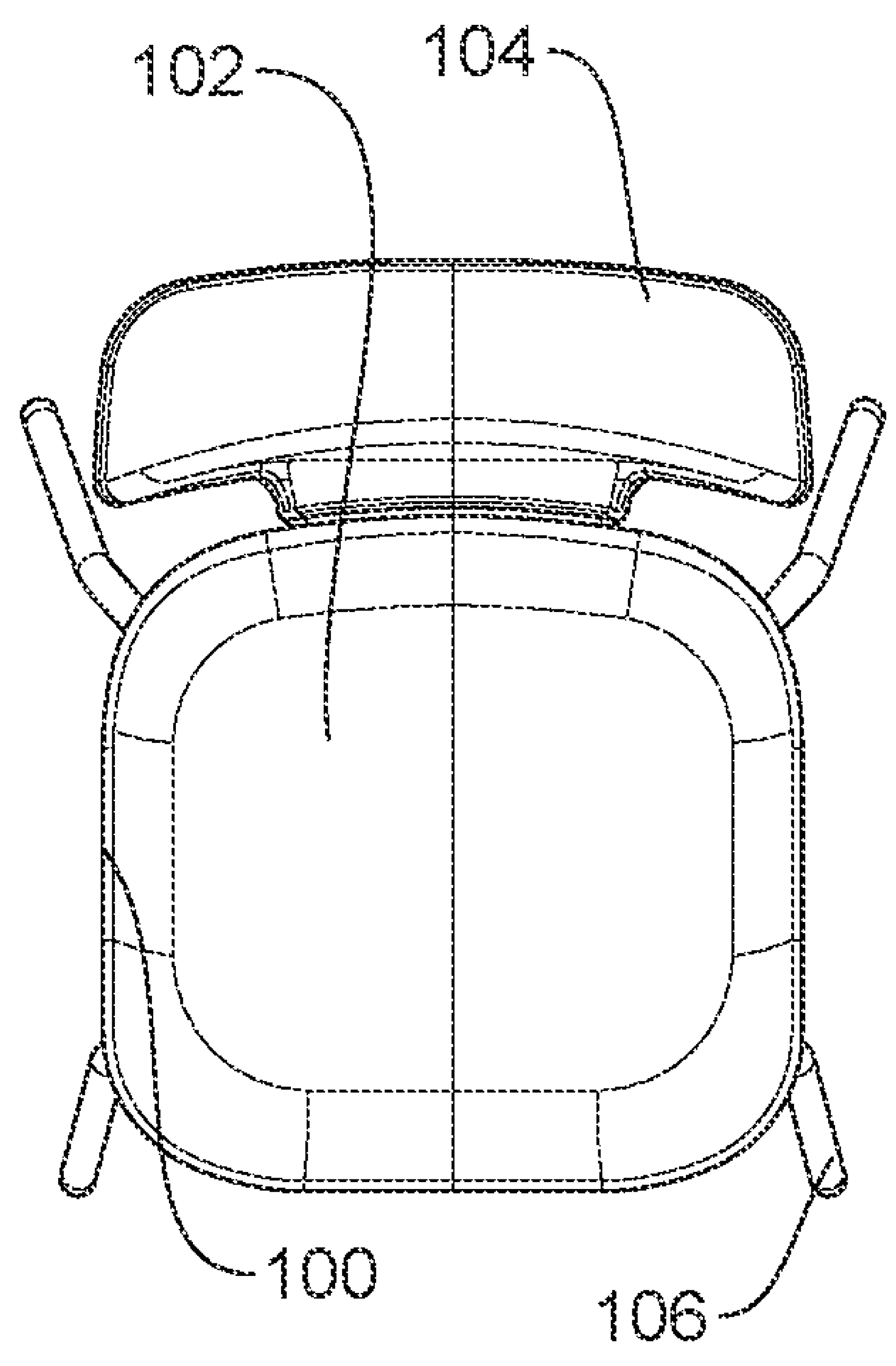


FIG. 6C

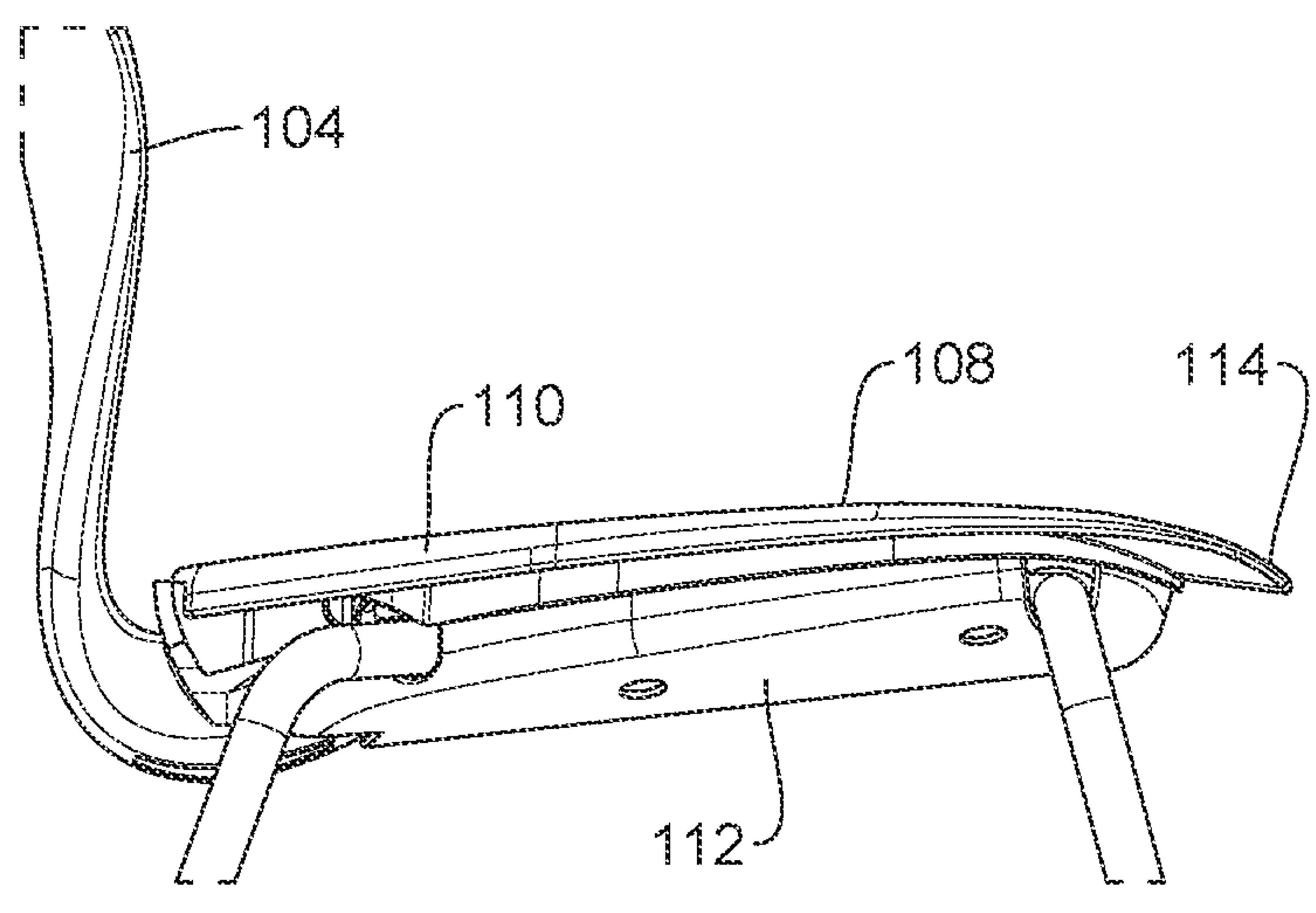


FIG. 6D

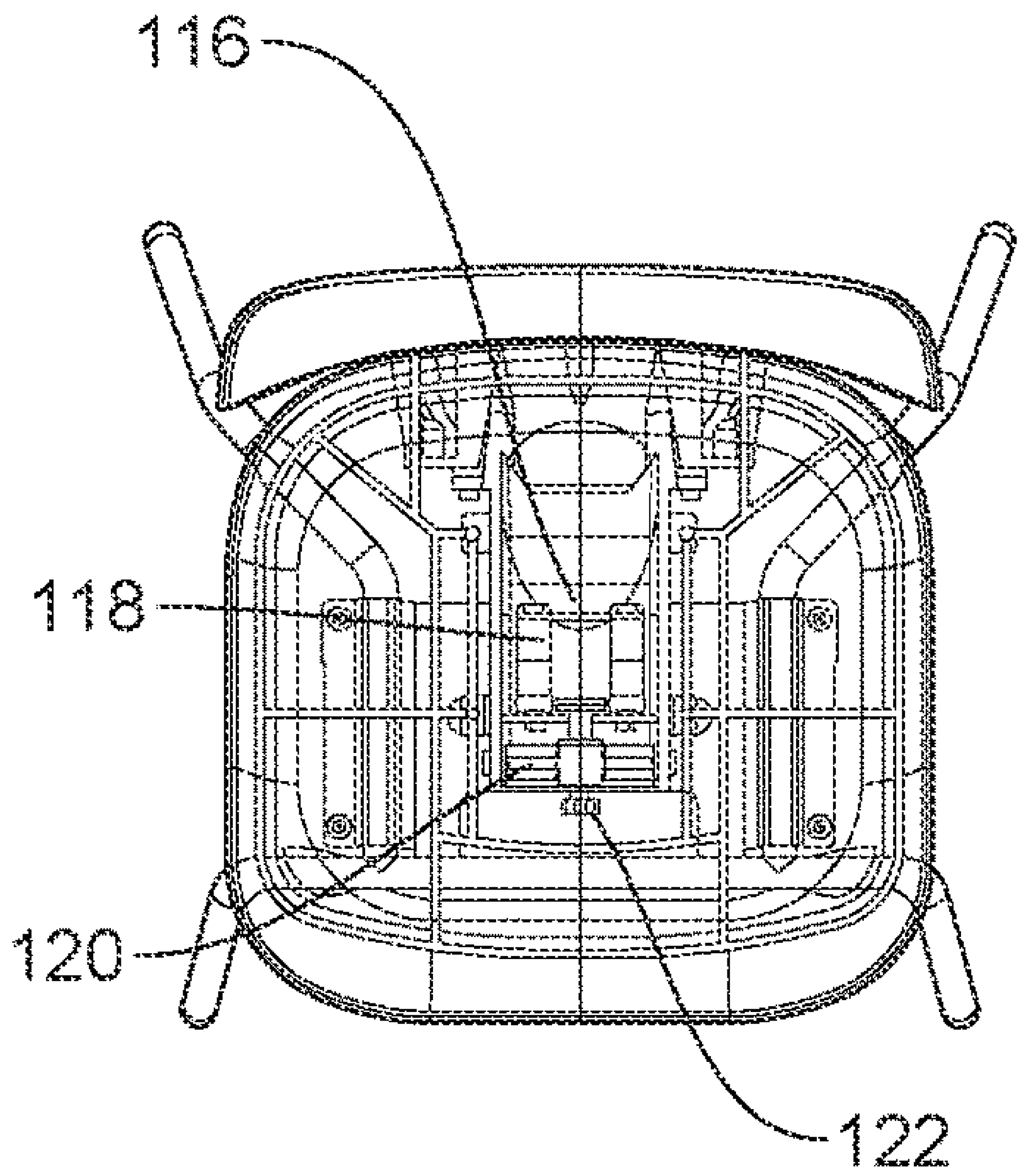


FIG. 7A

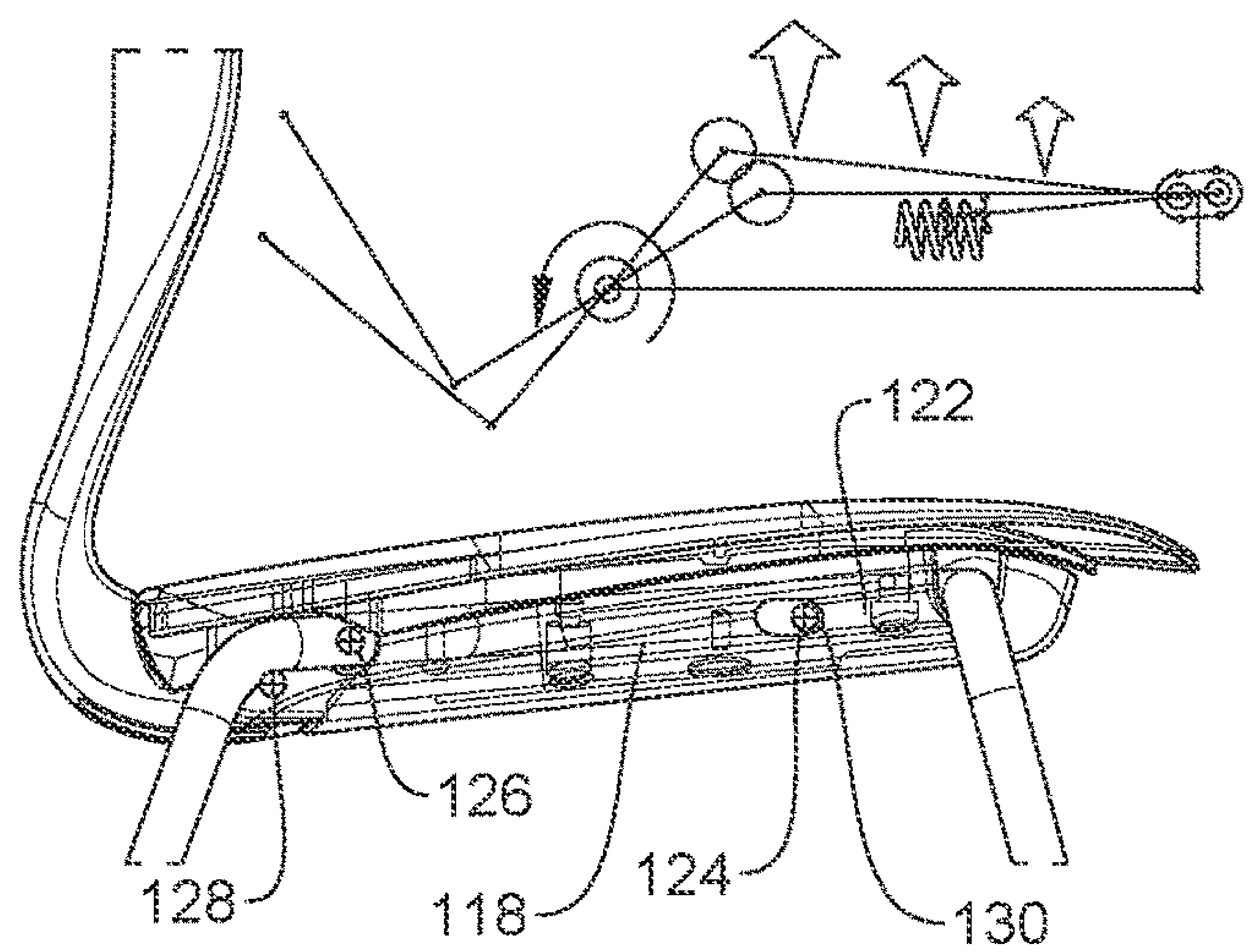


FIG. 7B

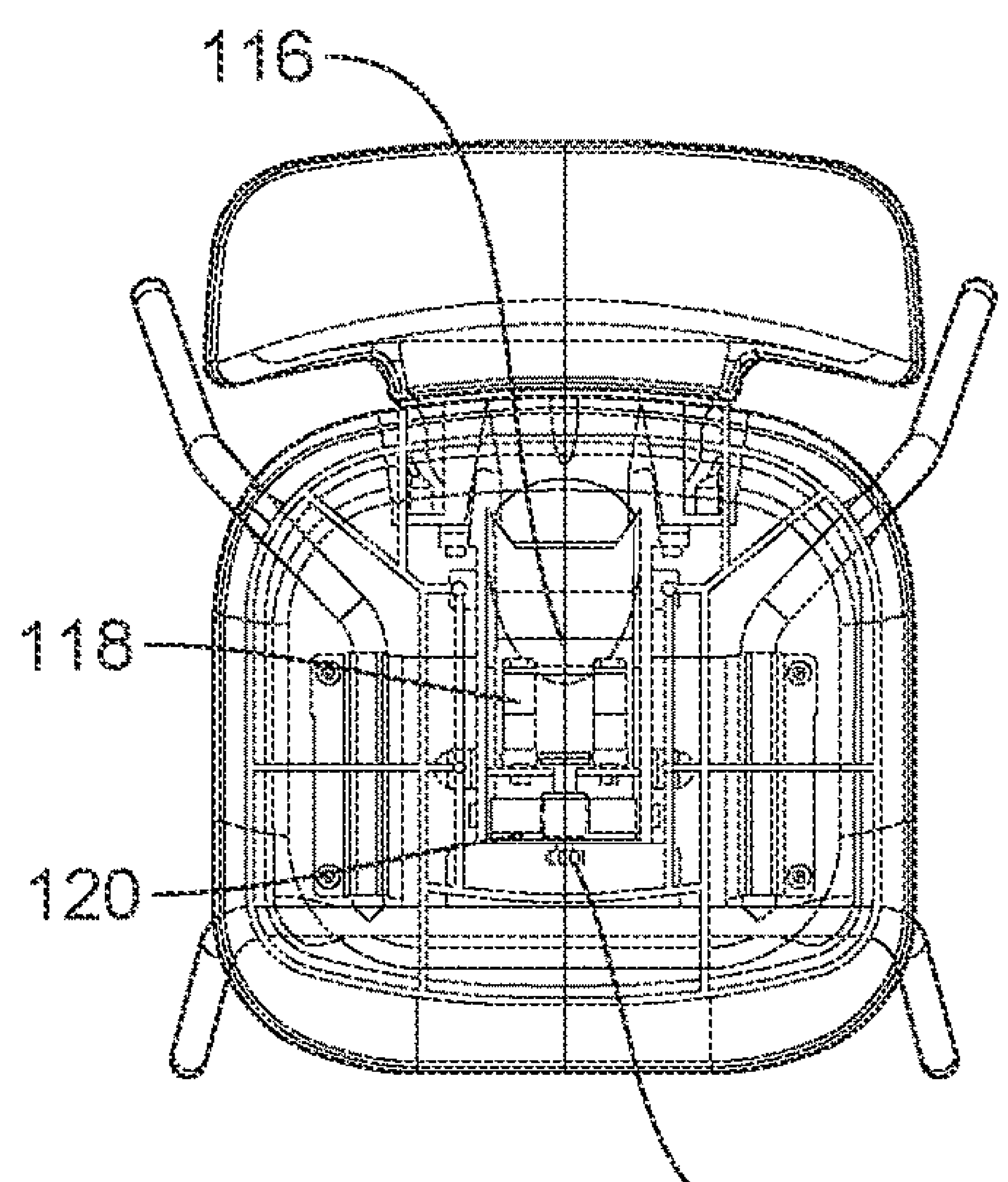


FIG. 7C

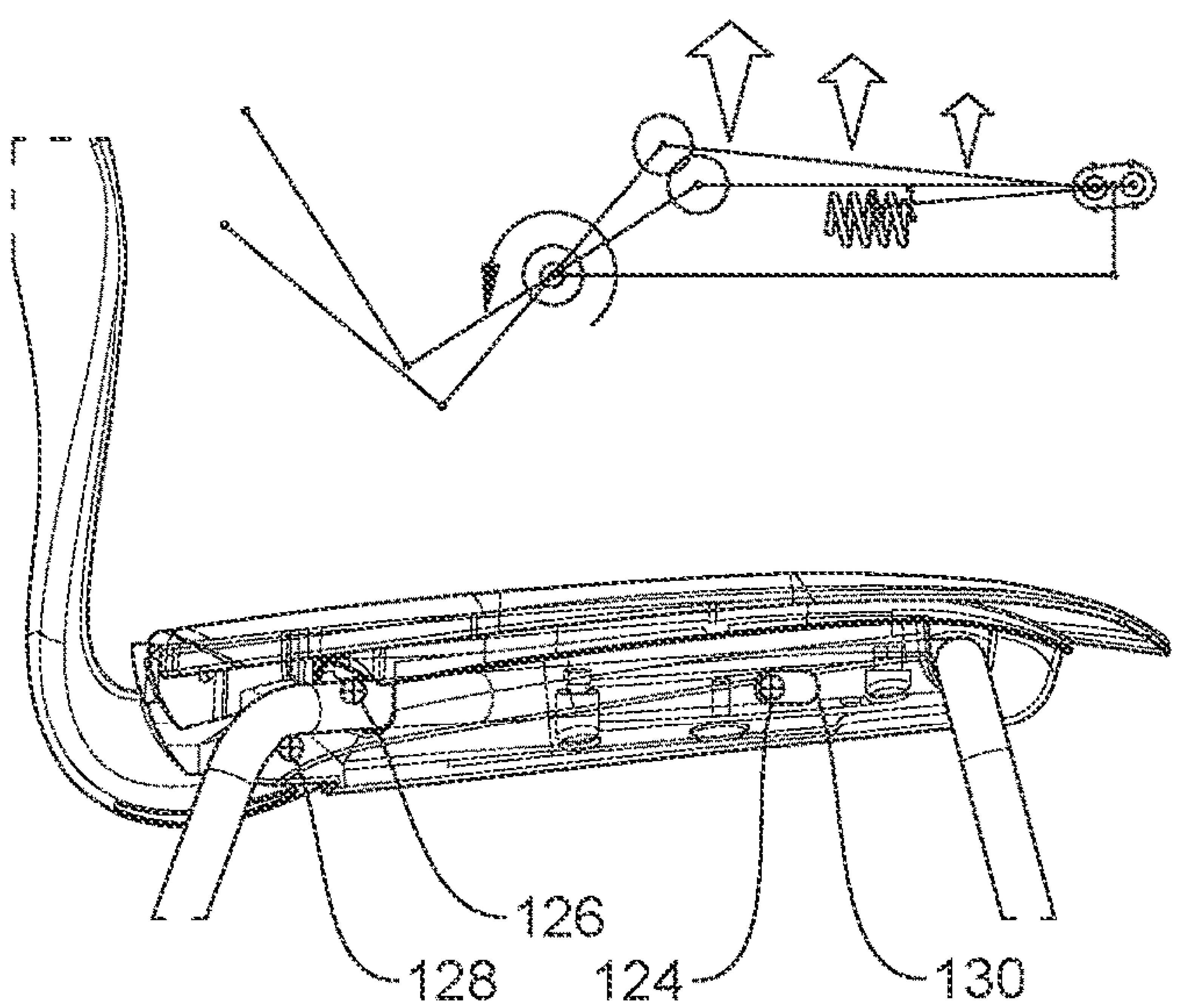


FIG. 7D

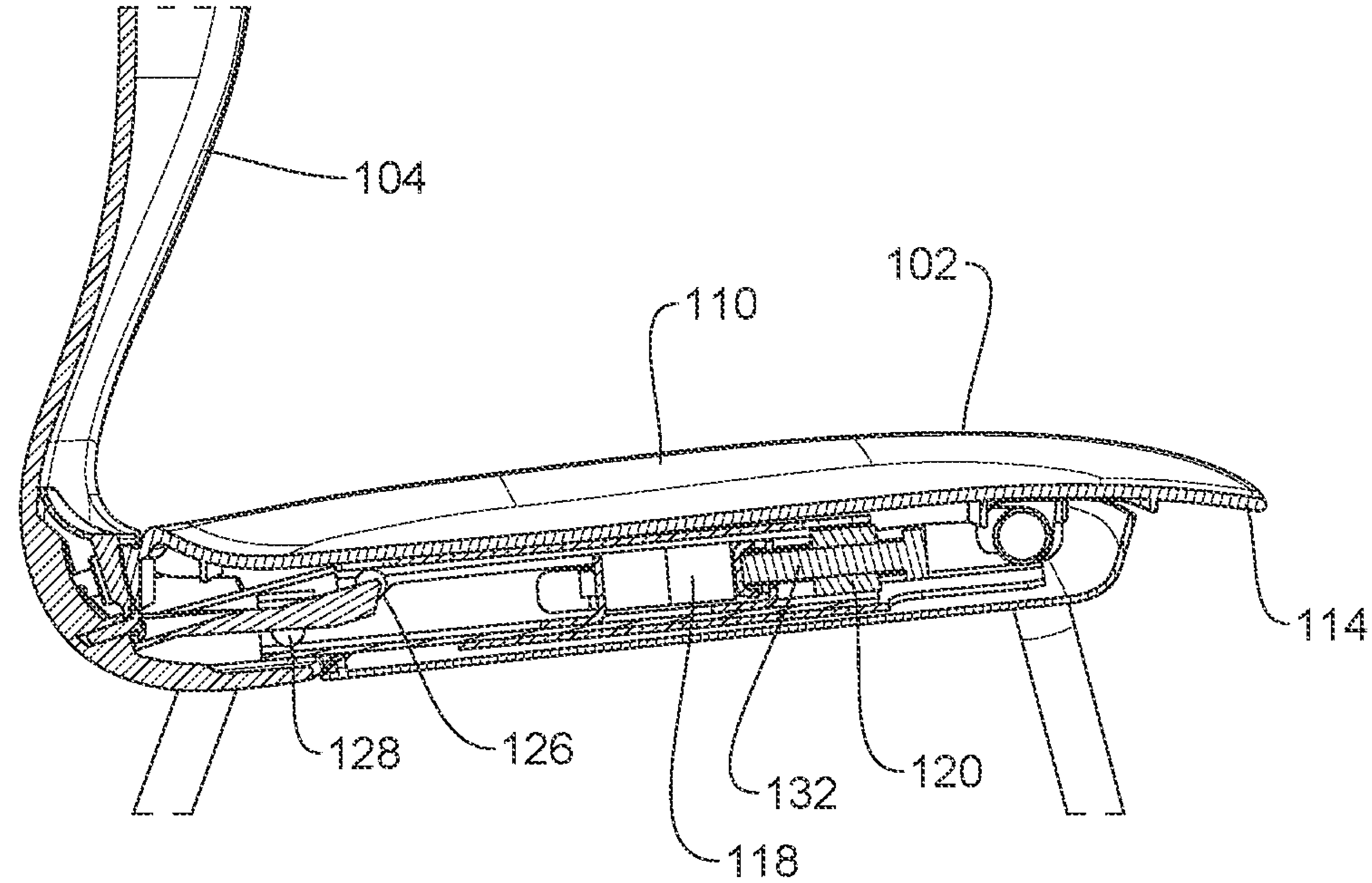

104
102
110
114
128
126
132
120
118

FIG. 8A

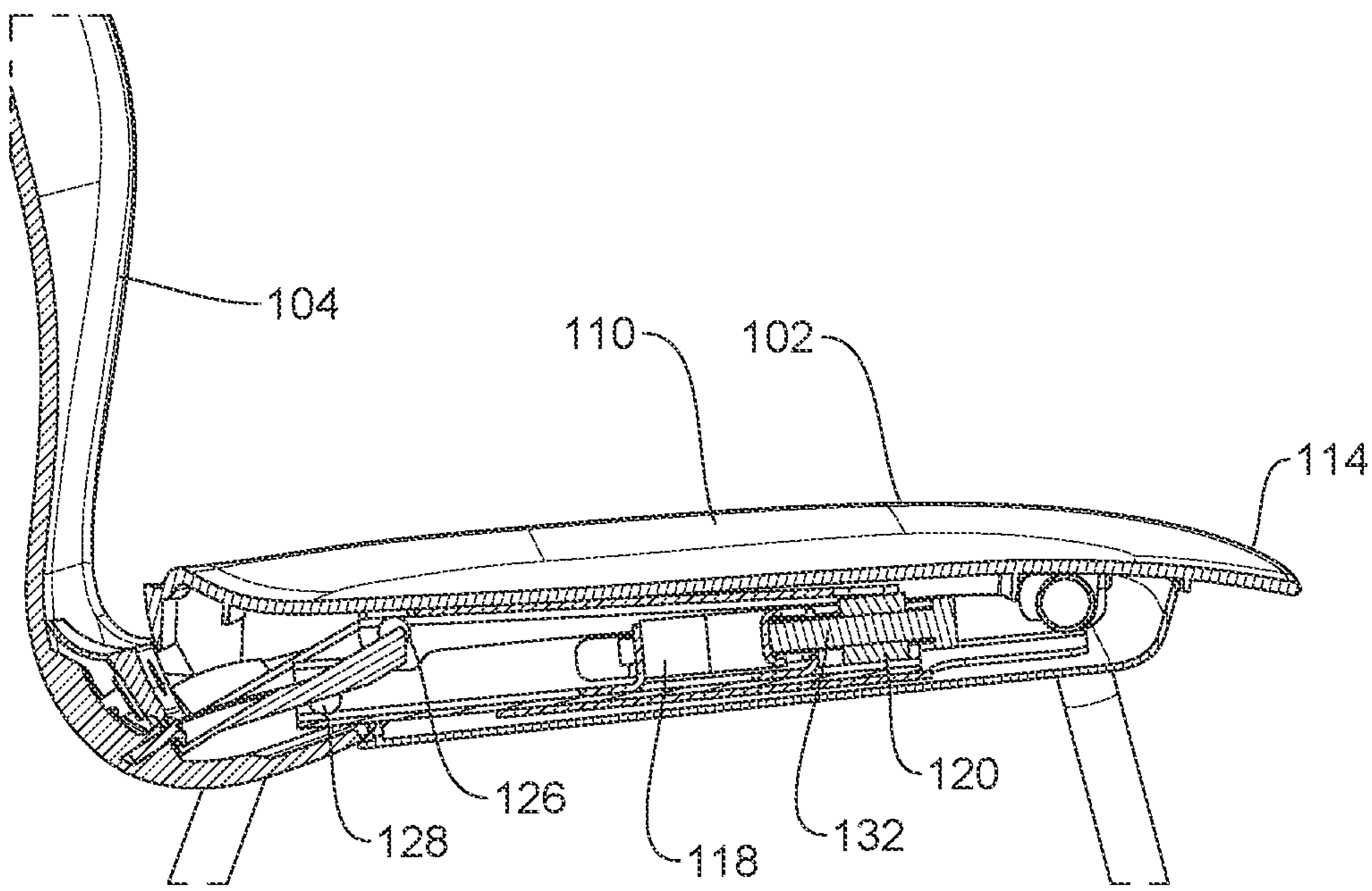

104
110
102
114
126
120
128
132
118

FIG. 8B

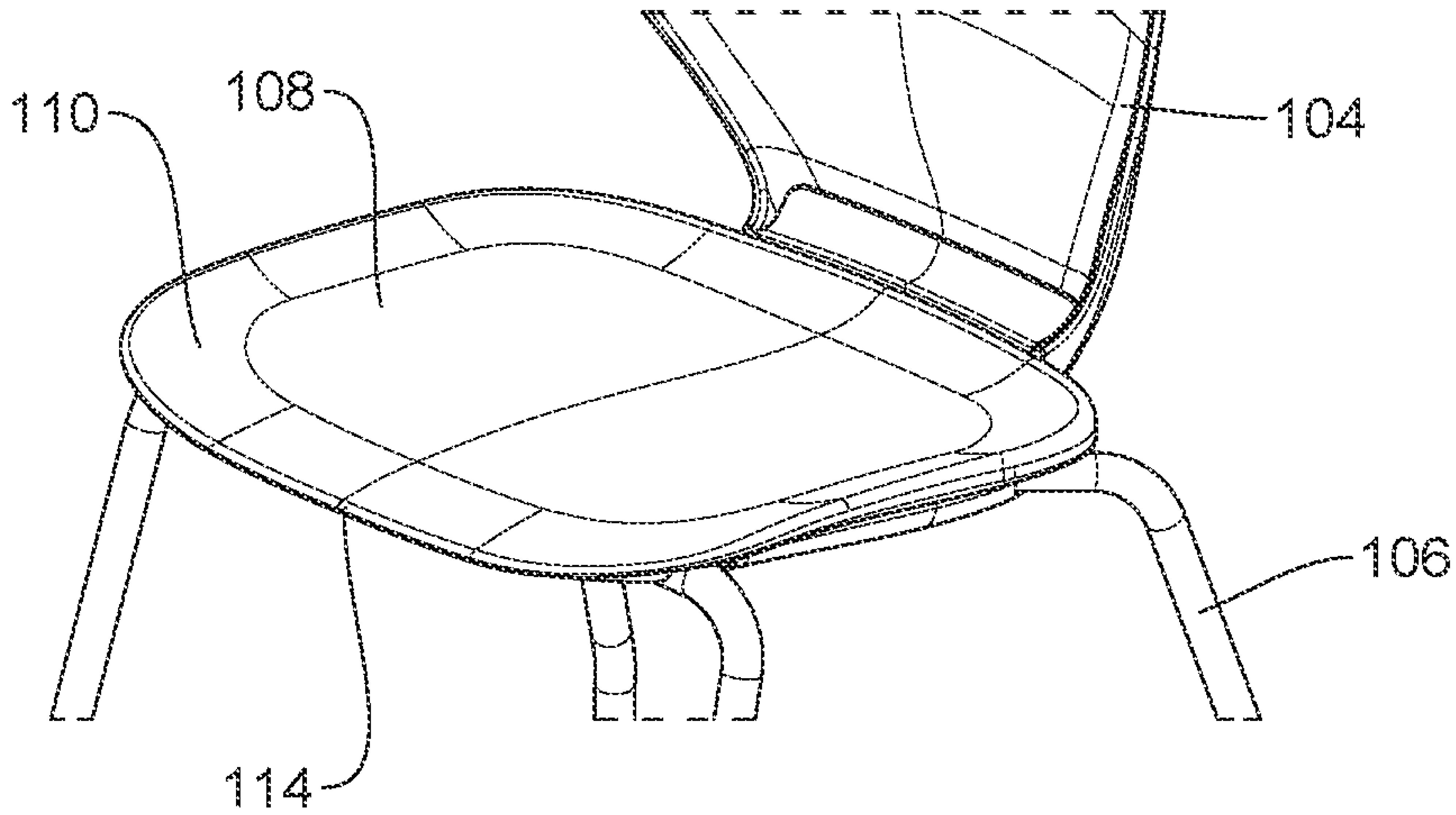


FIG. 9A

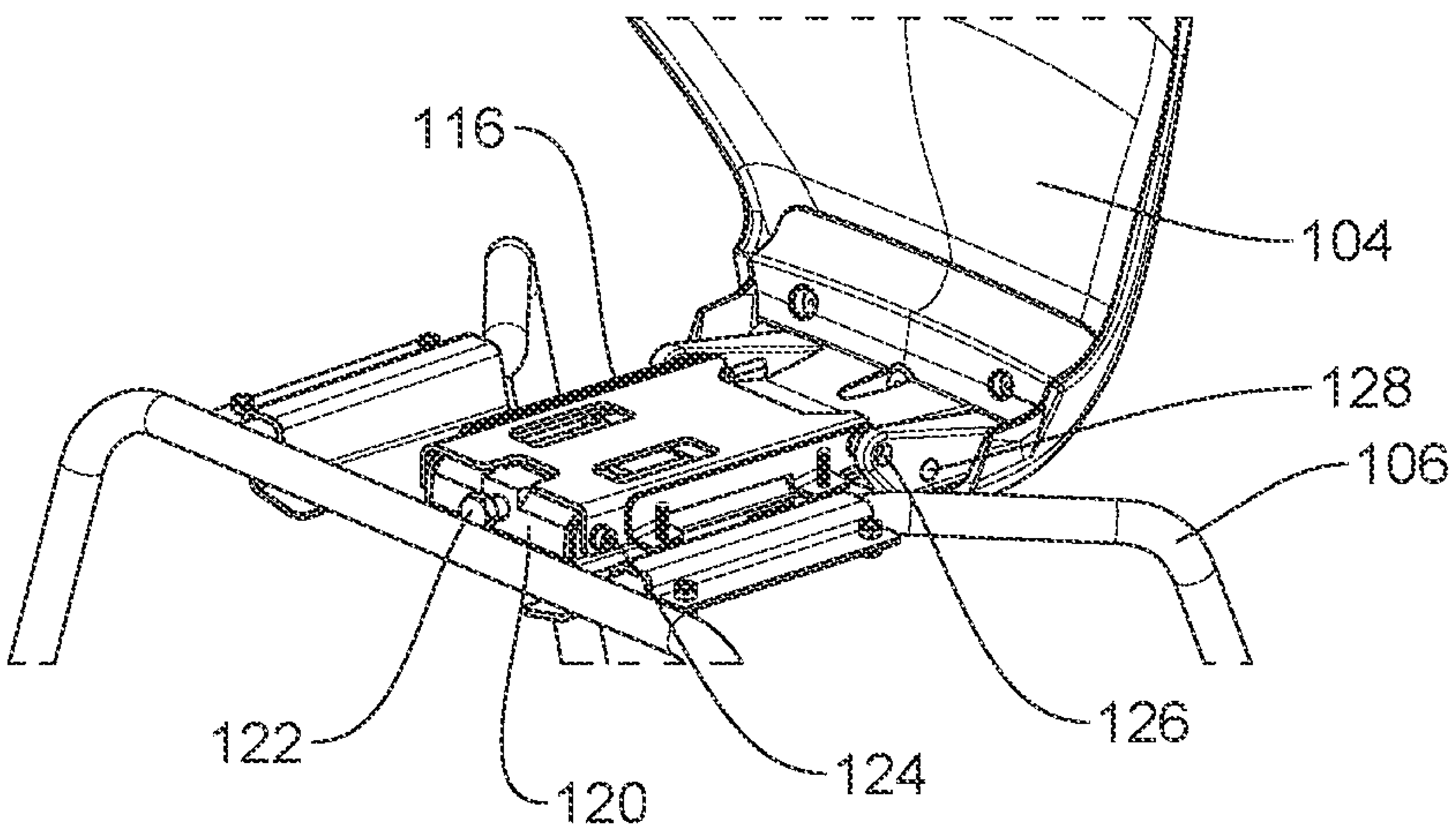


FIG. 9B

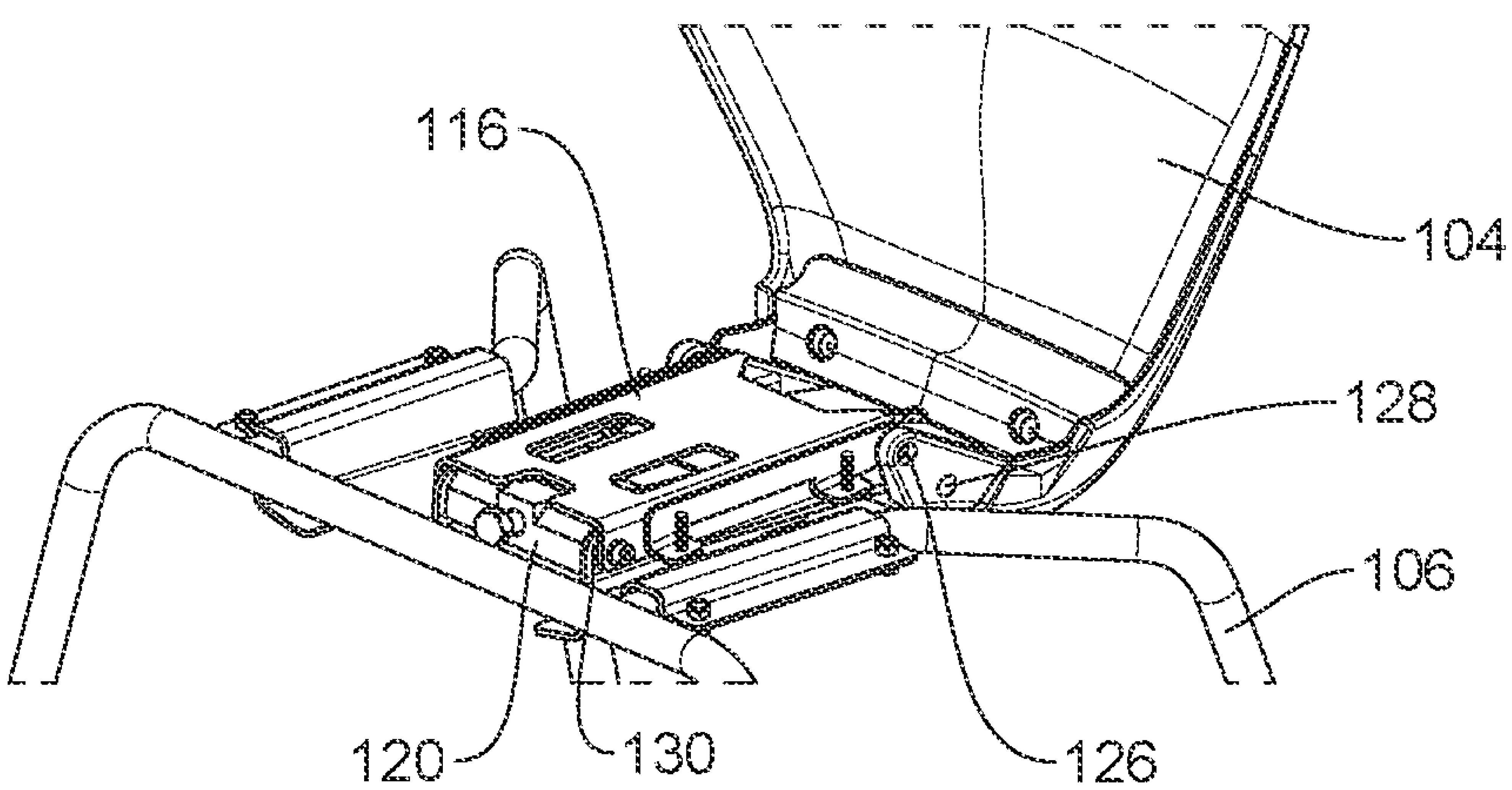


FIG. 9C

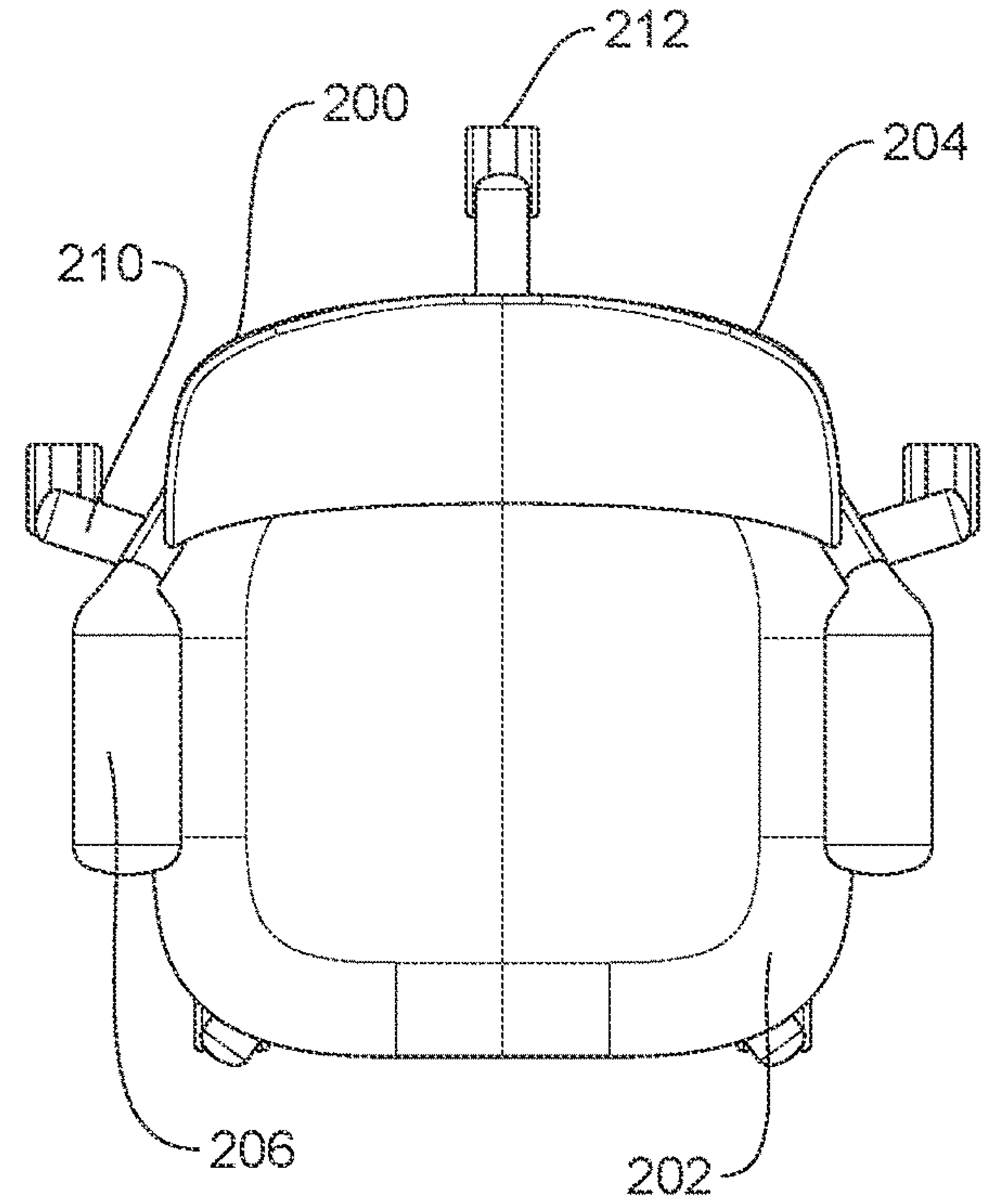


FIG. 10A

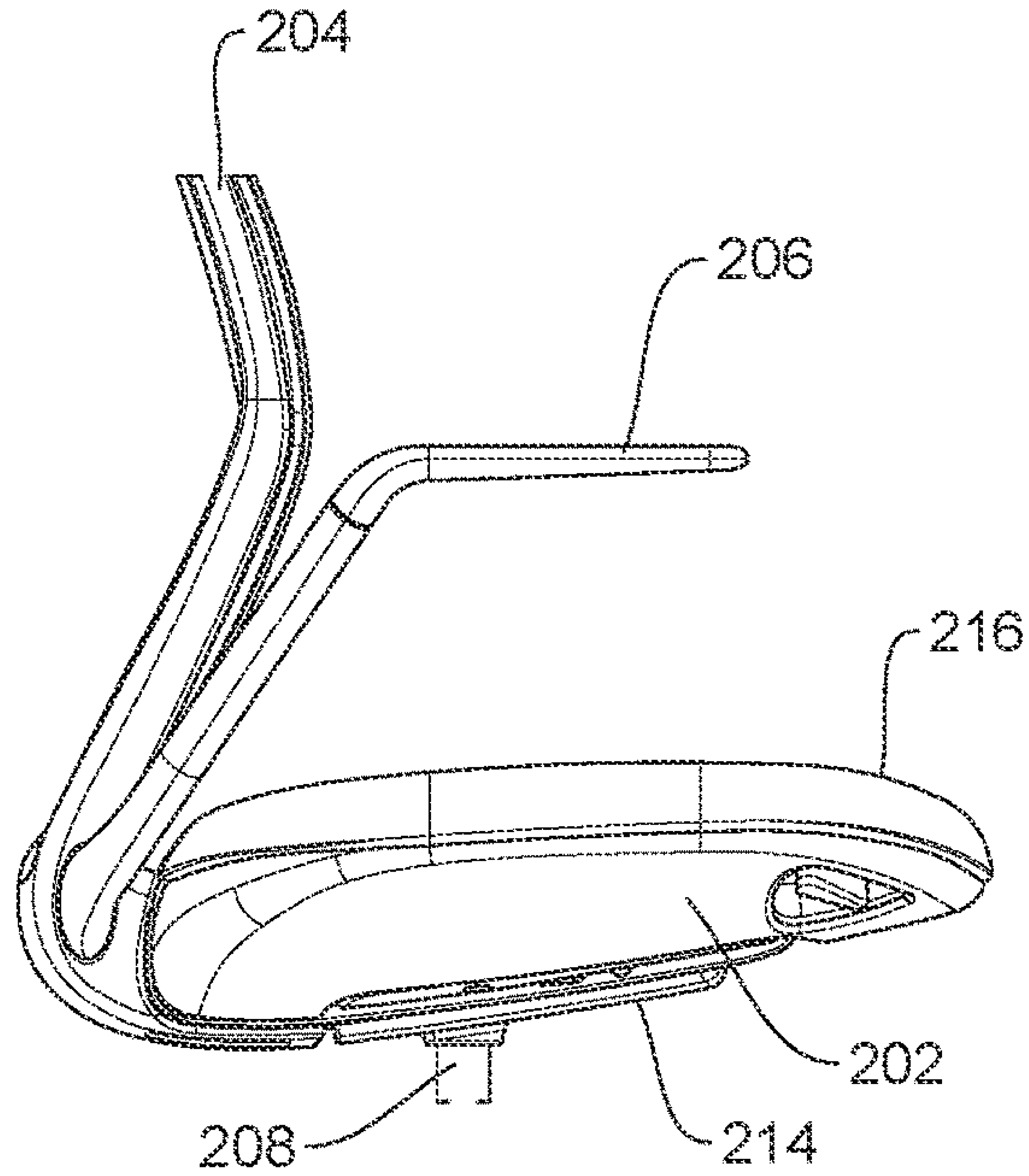


FIG. 10B

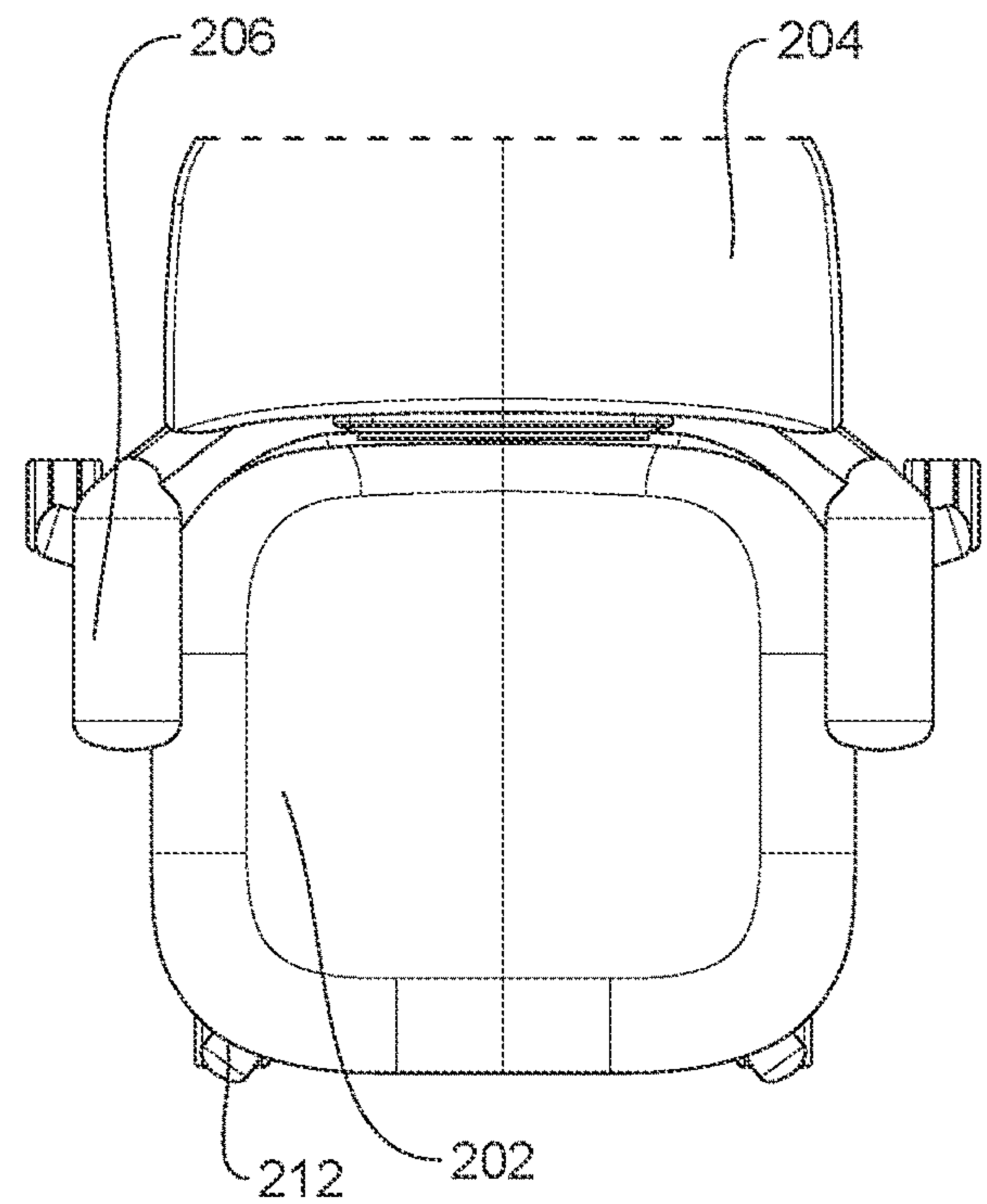


FIG. 10C

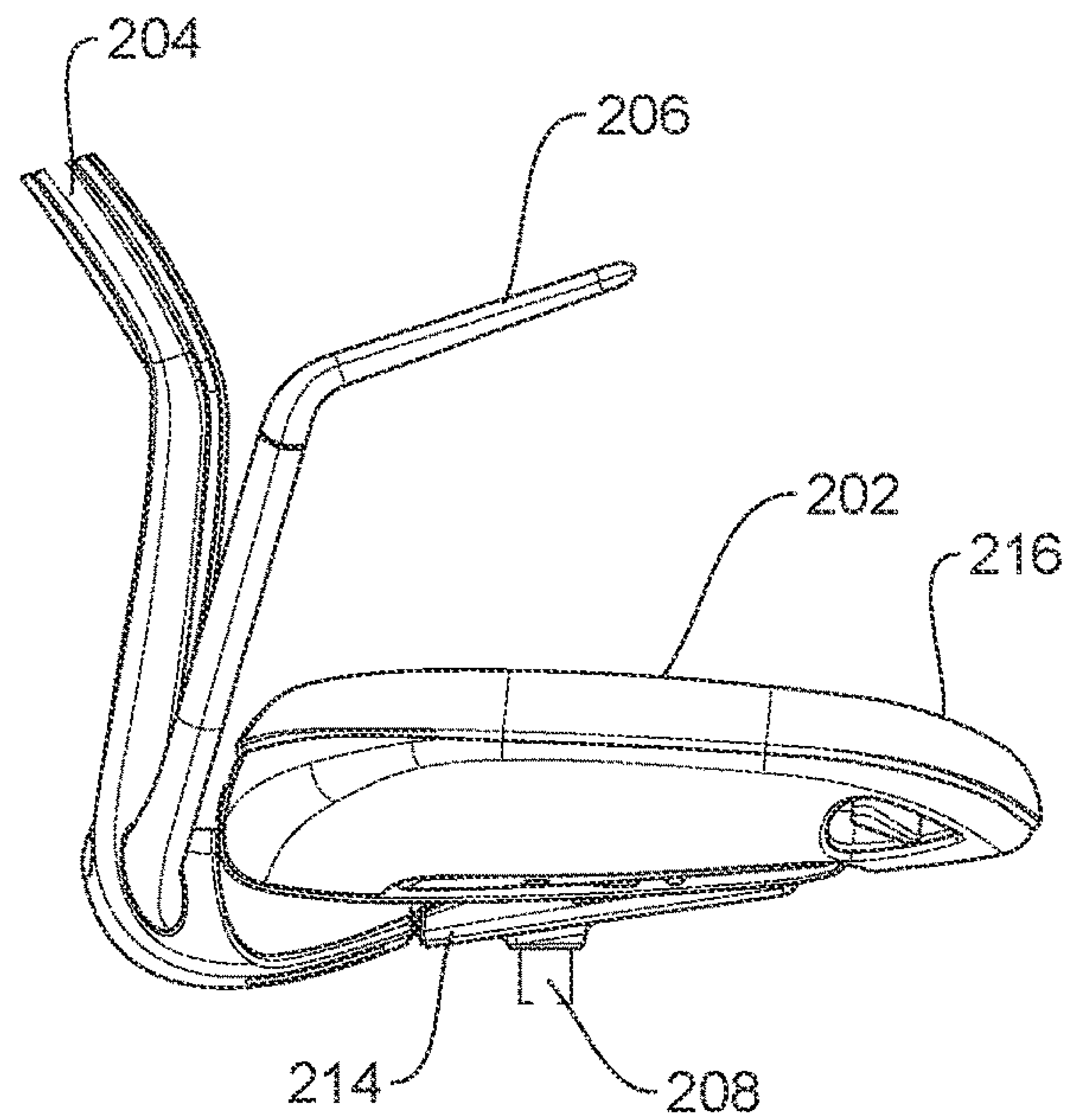


FIG. 10D

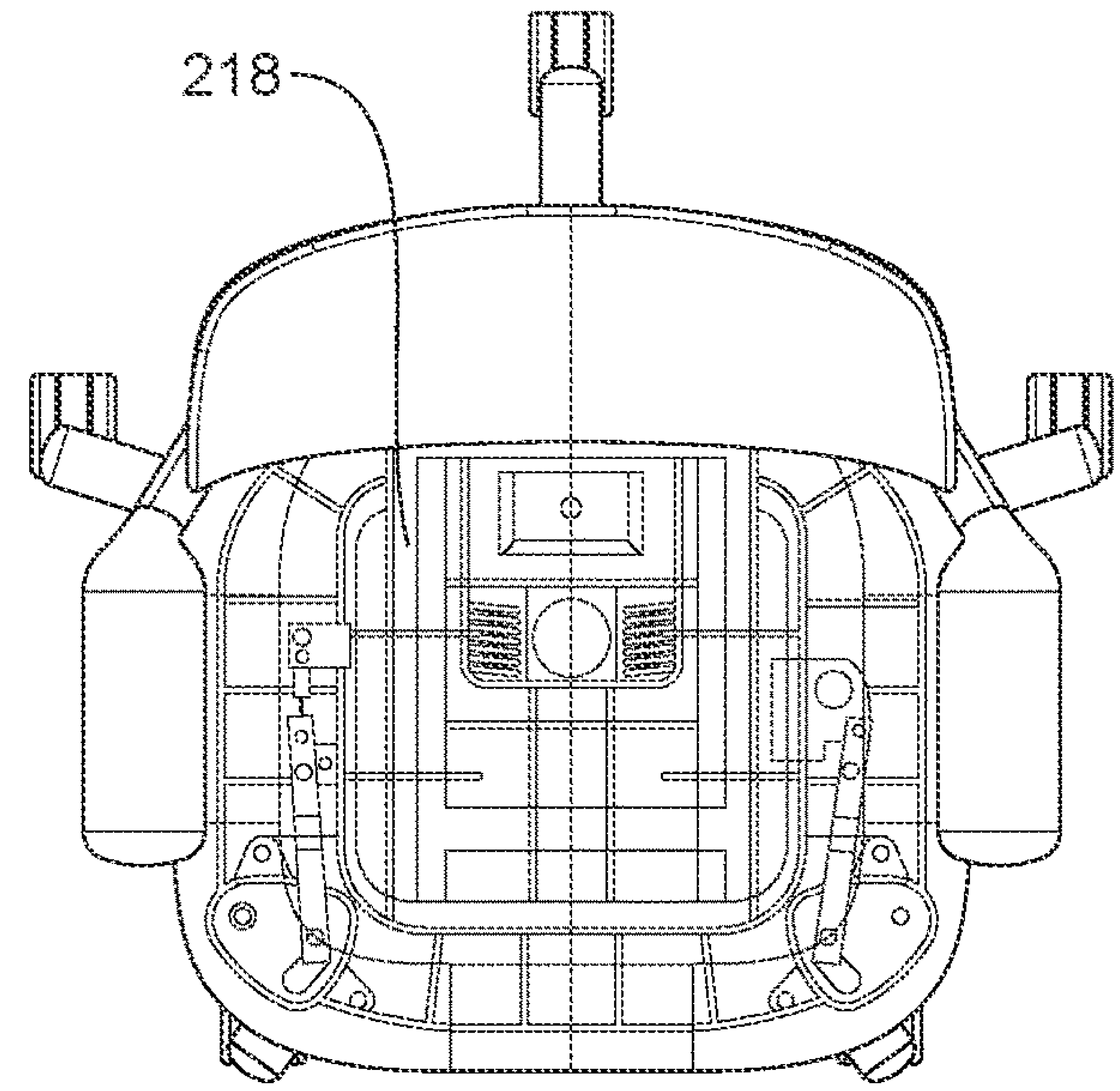


FIG. 11A

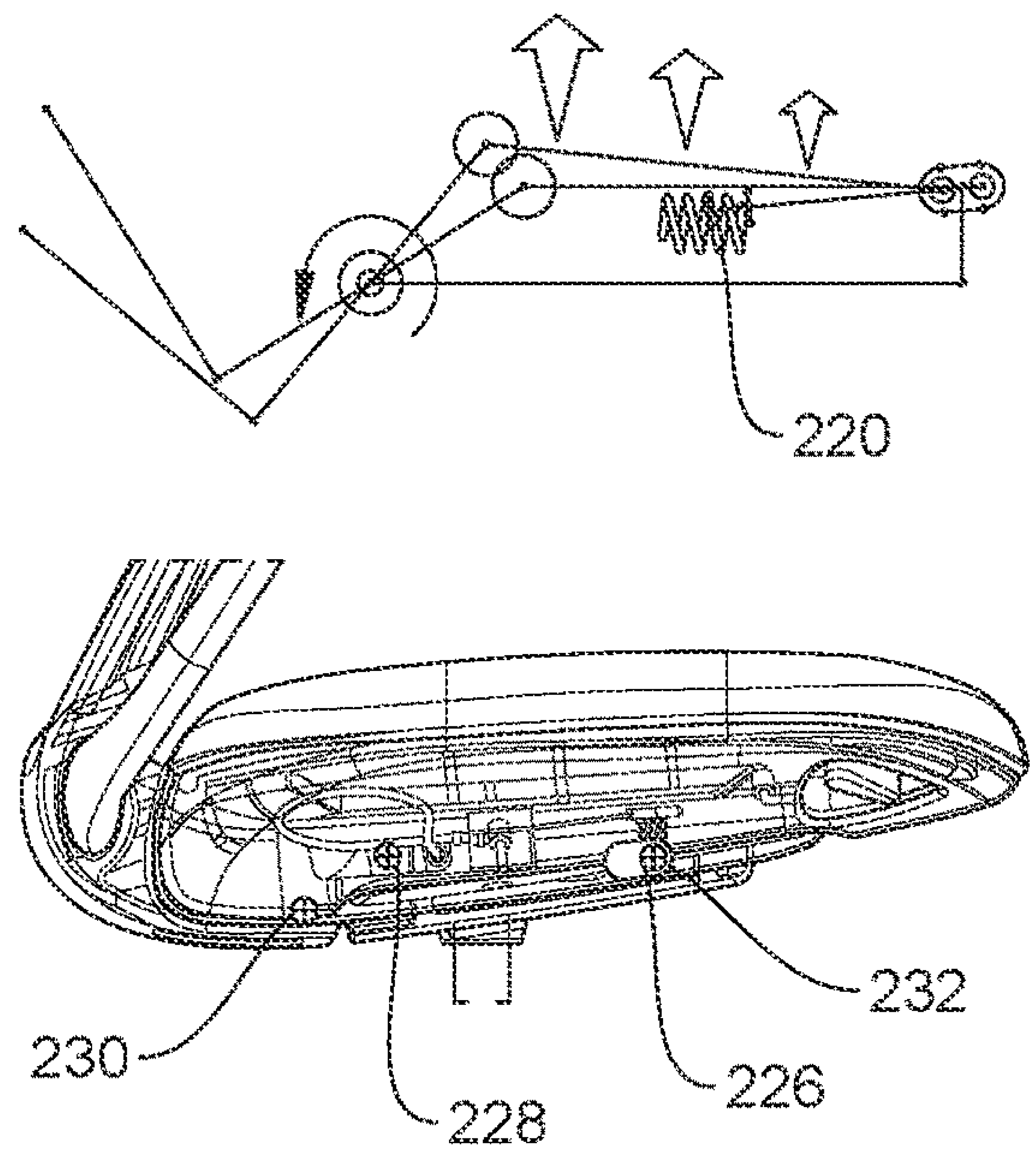


FIG. 11B

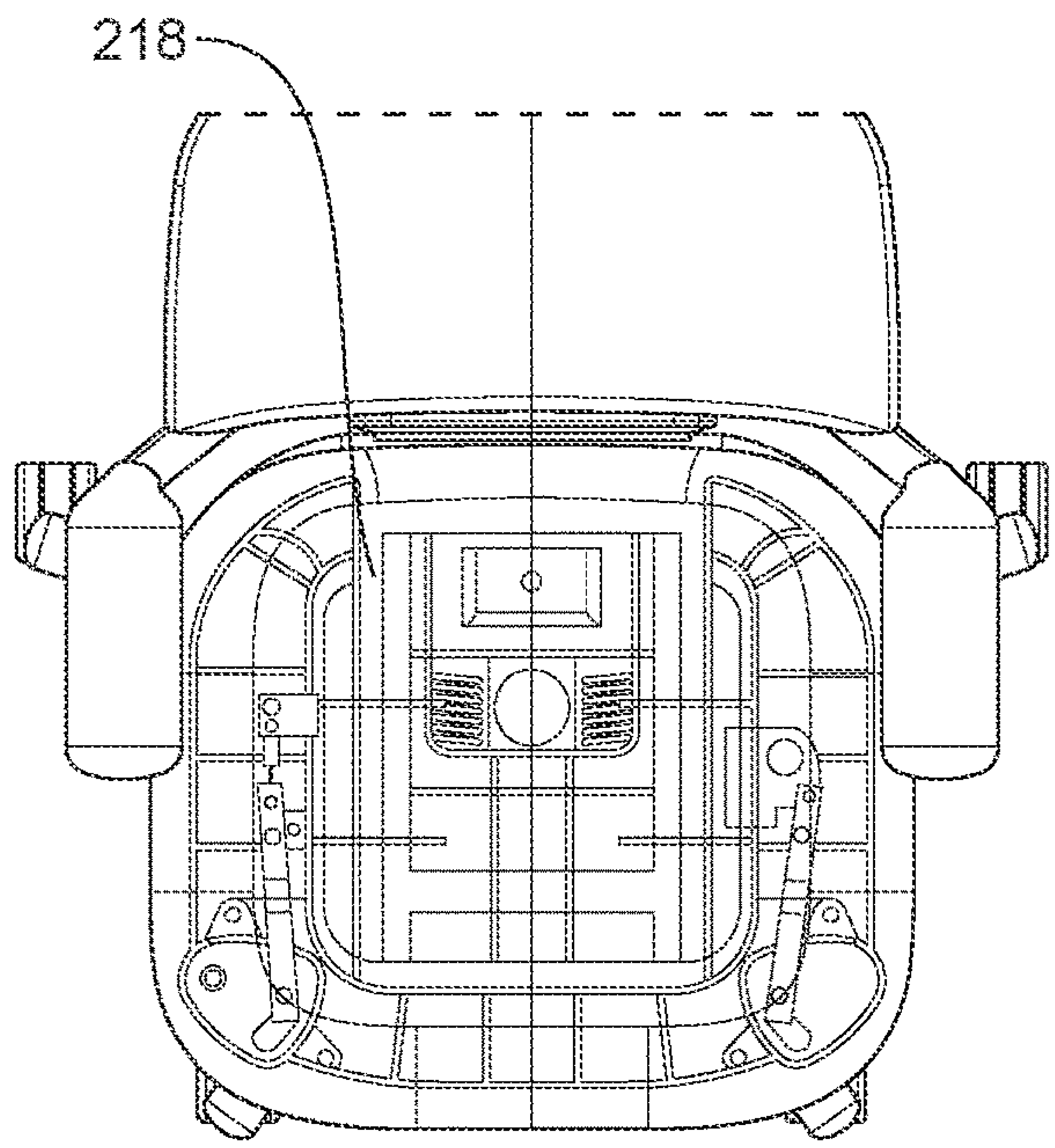


FIG. 11C

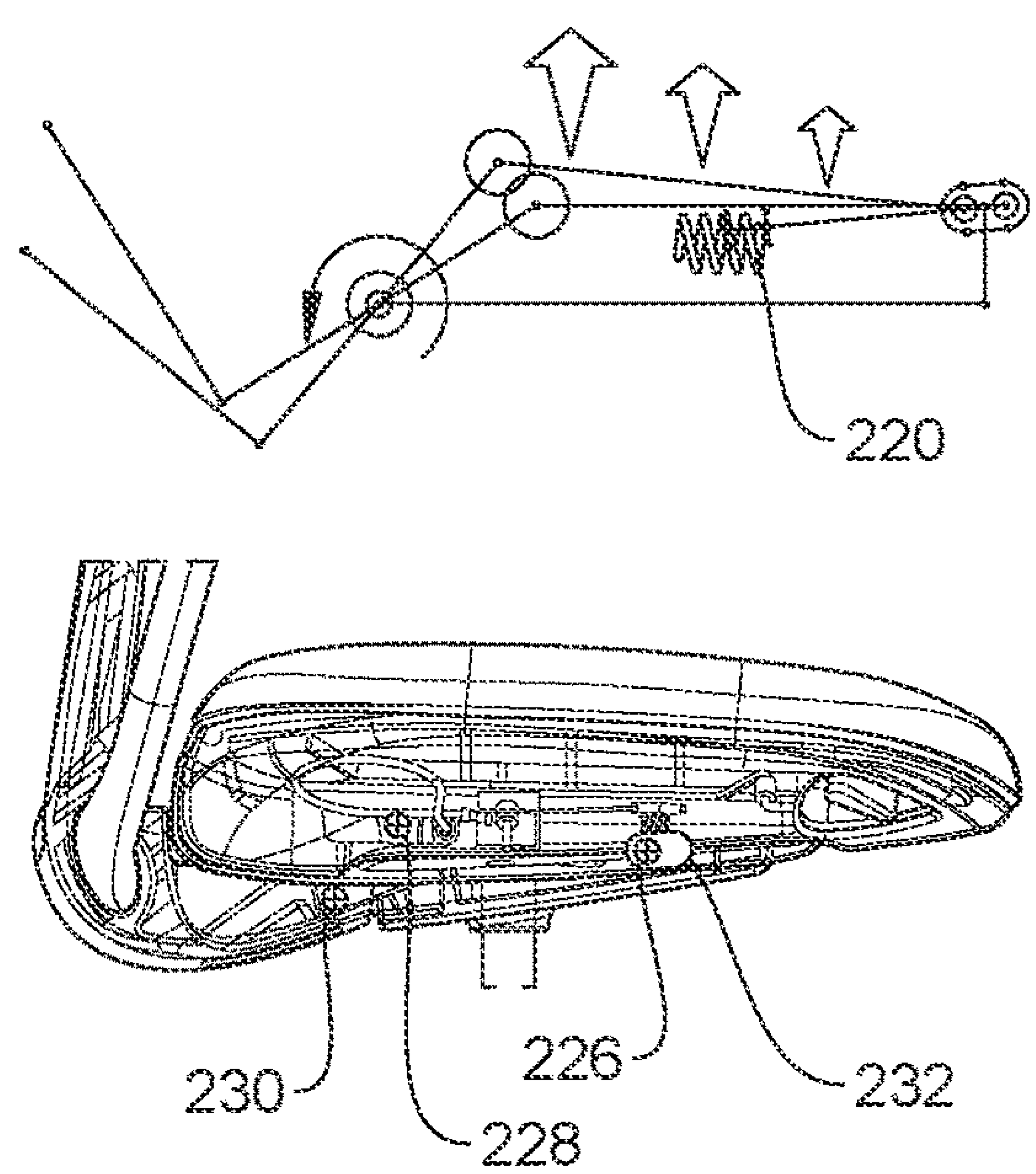


FIG. 11D

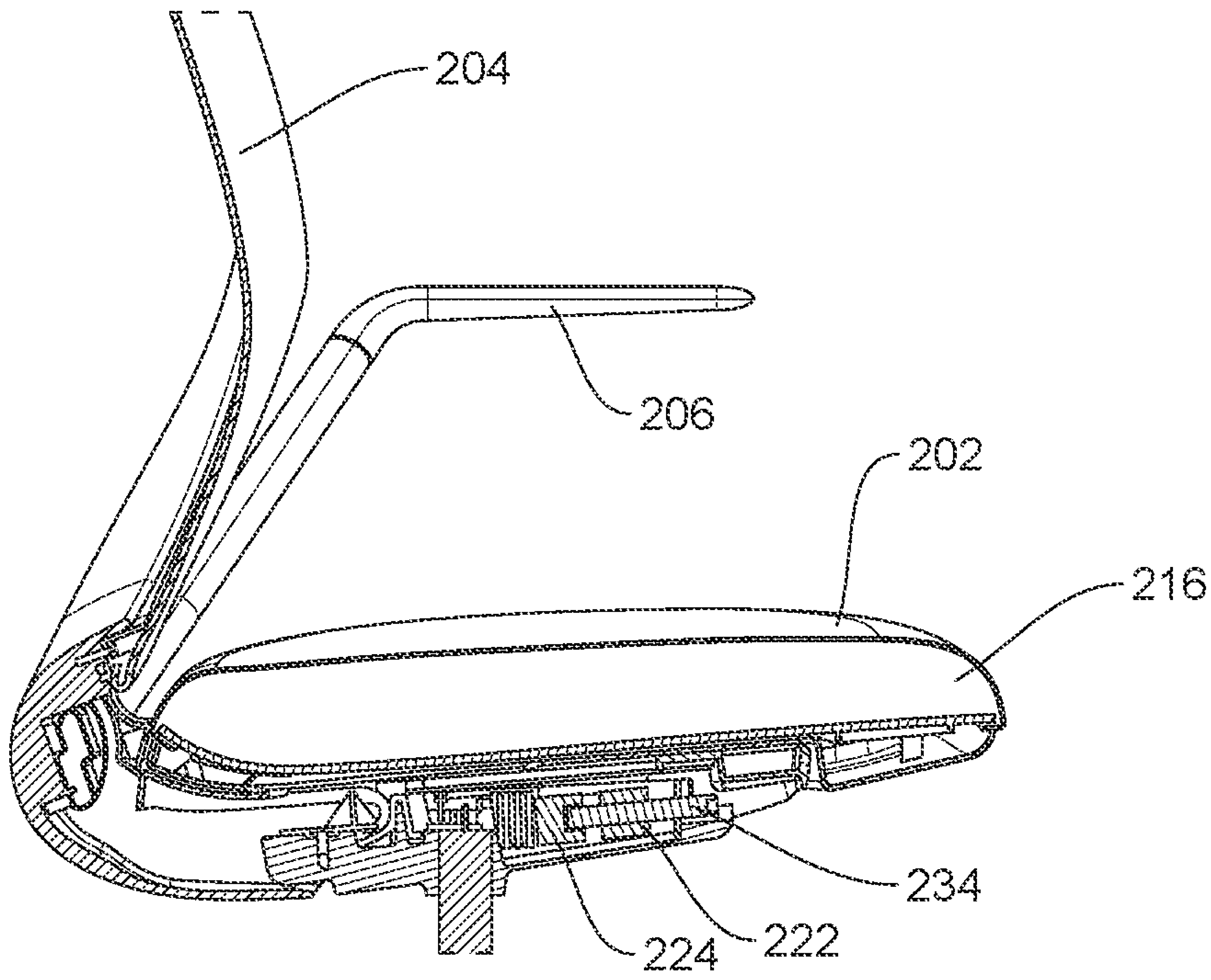


FIG. 12A

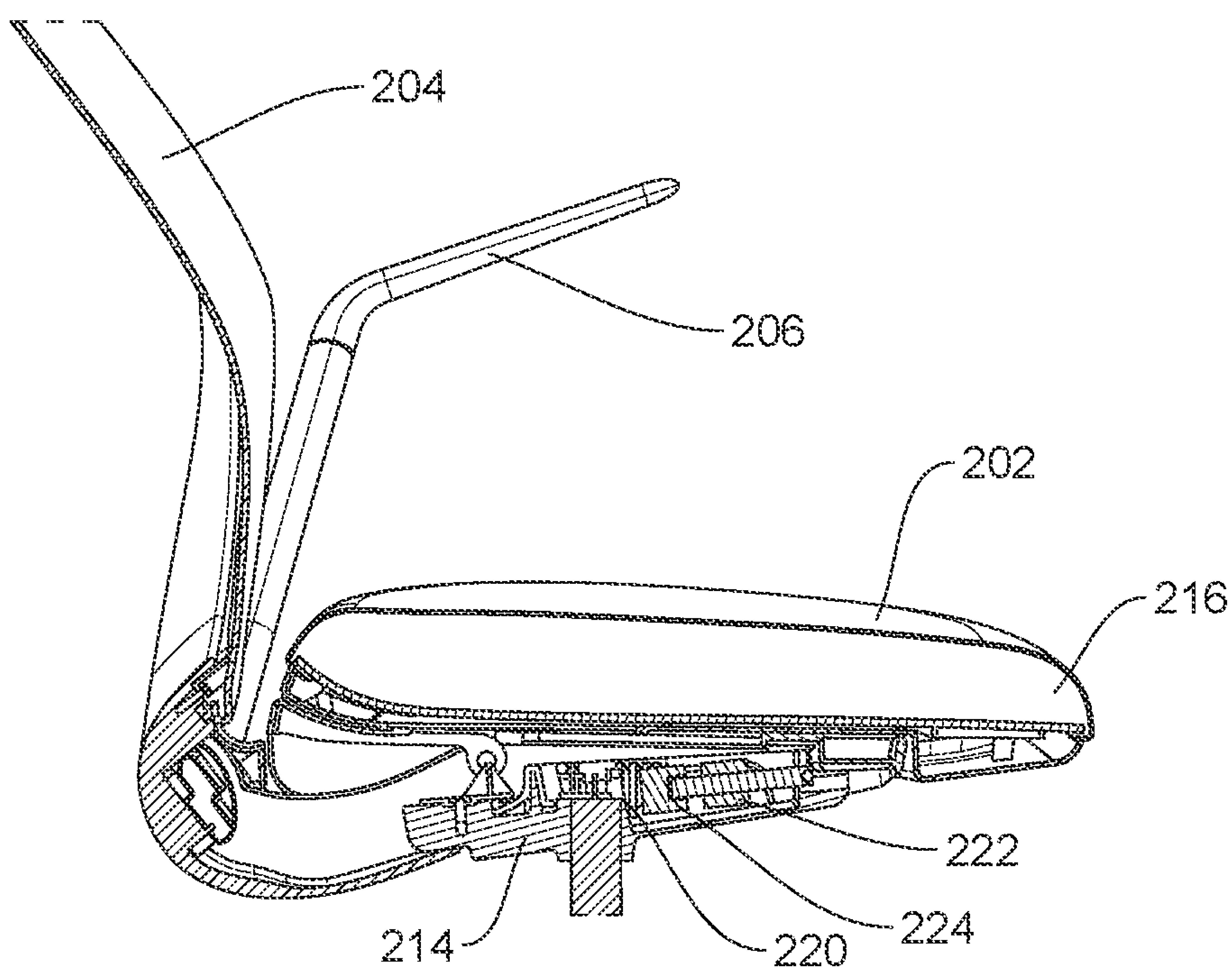


FIG. 12B

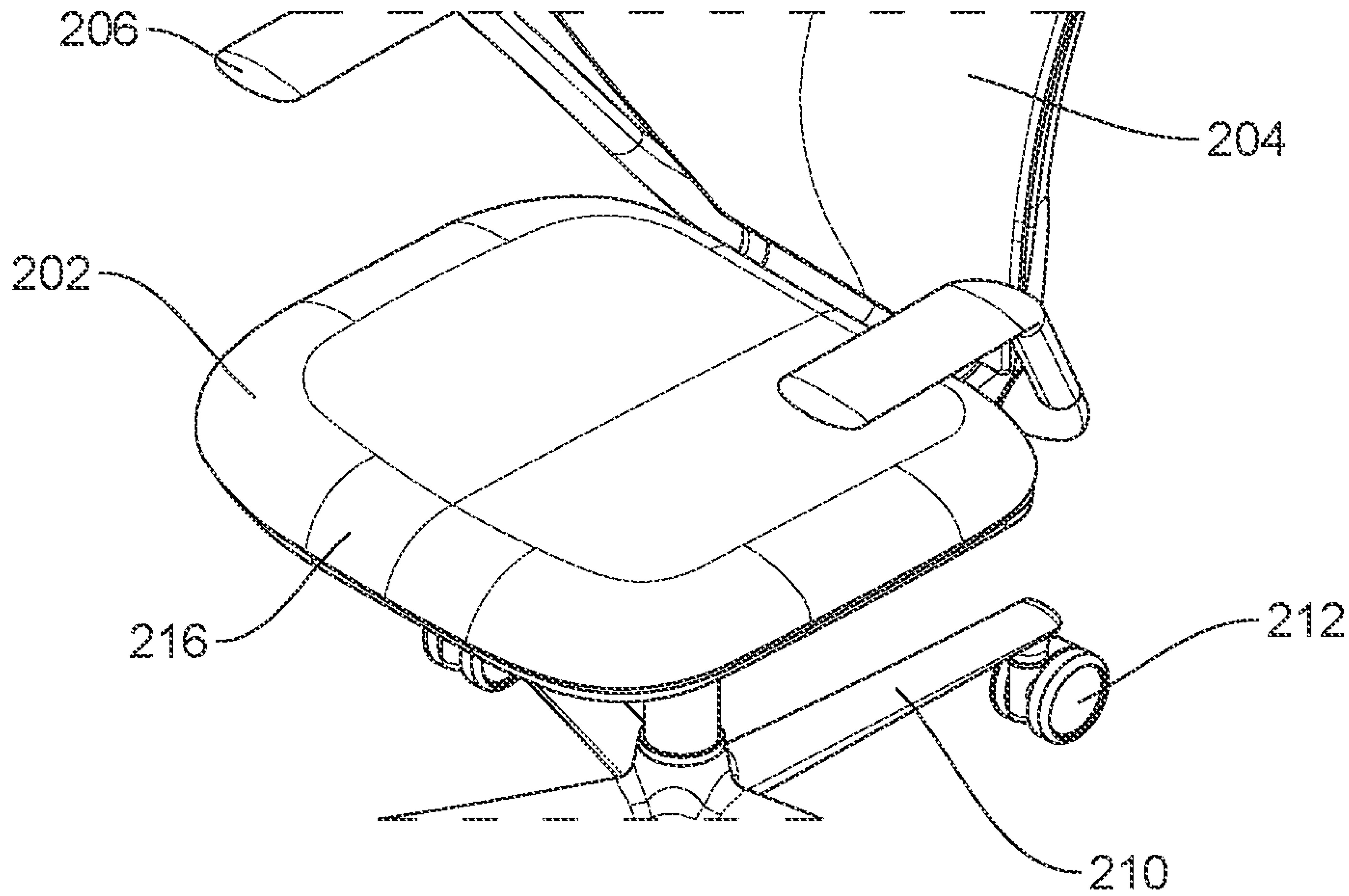


FIG. 13A

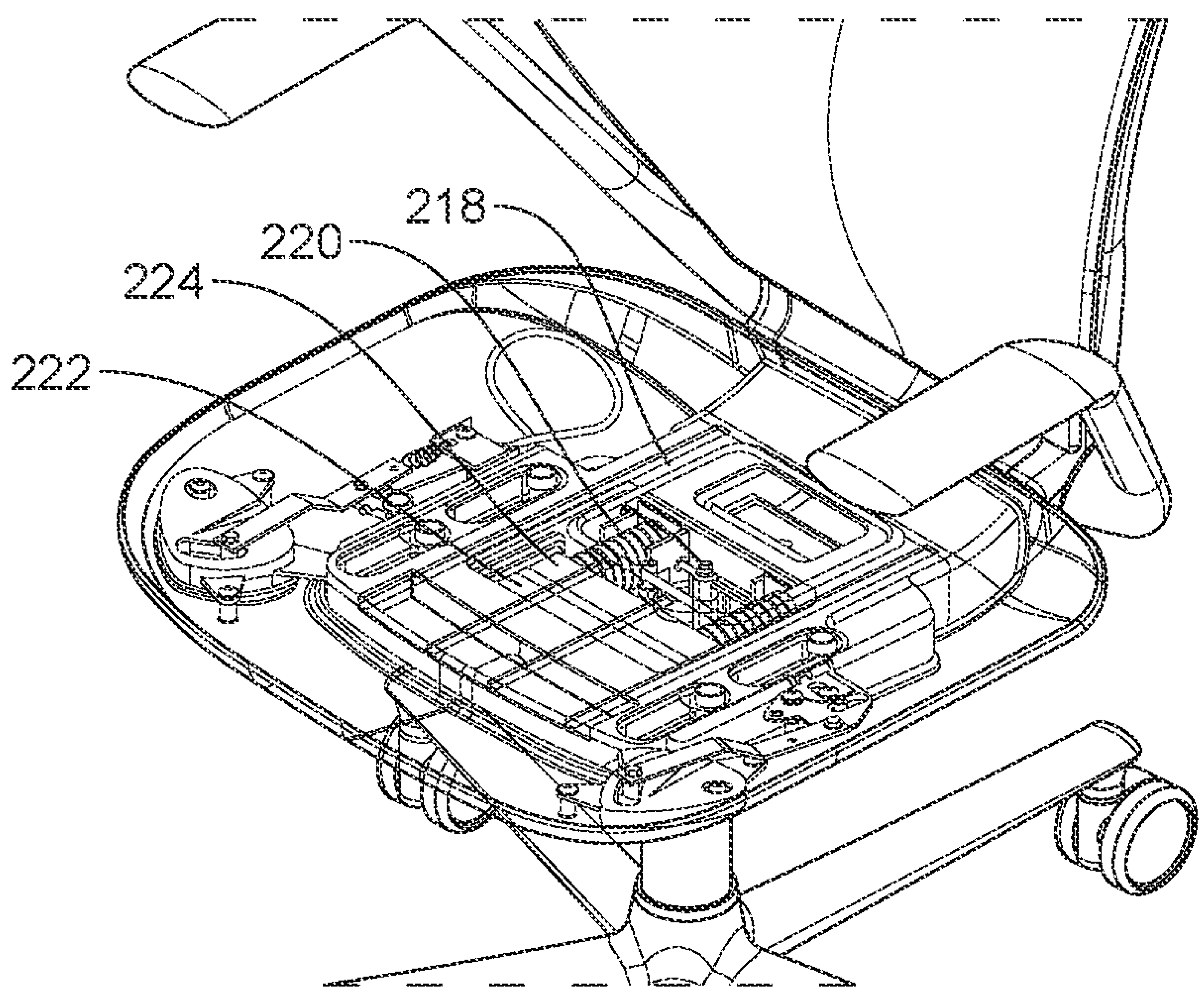


FIG. 13B

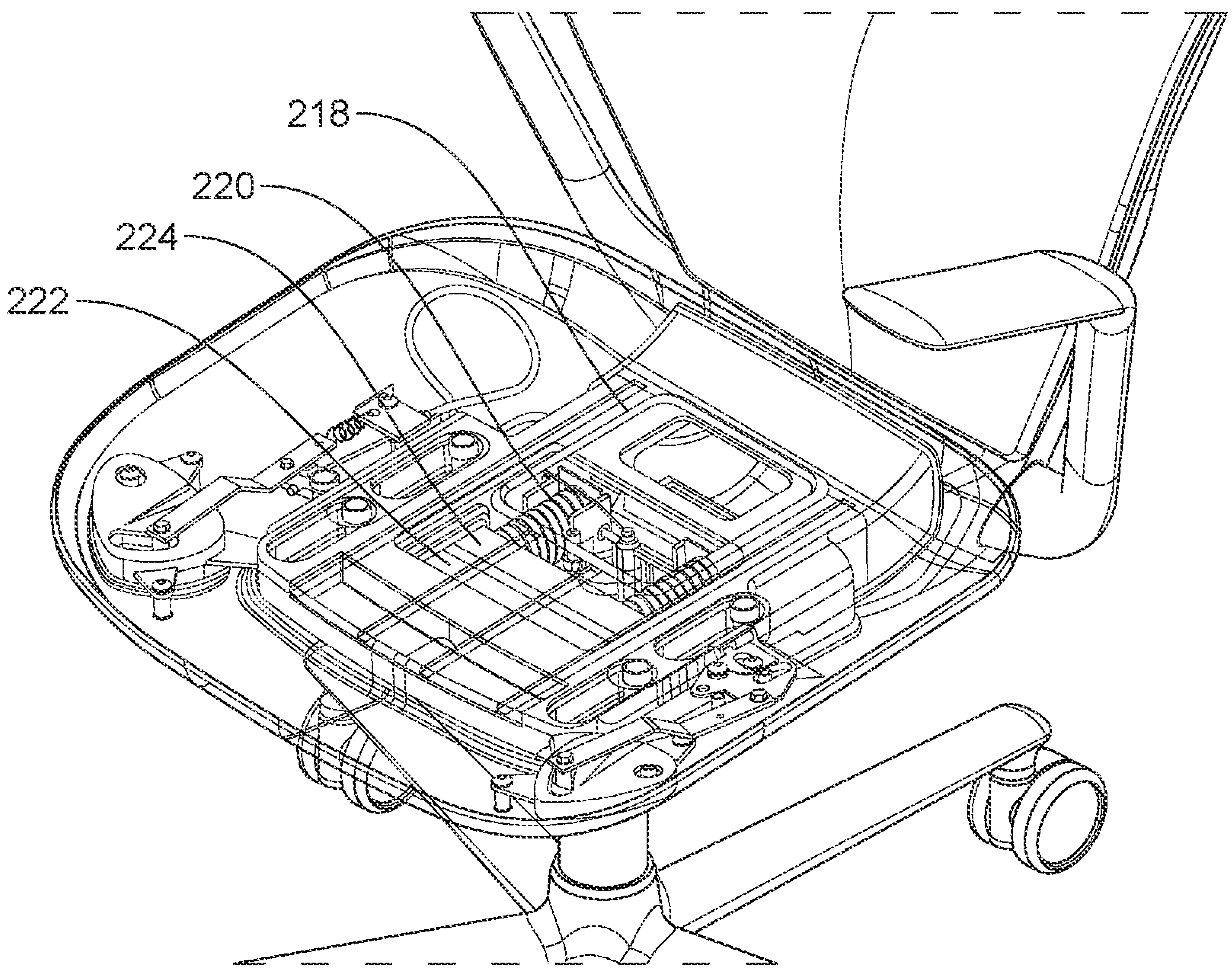


FIG. 13C

SYNCHRONOUS-TILT RECLINING CHAIR

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 USC § 119(e) of U.S. Provisional Patent Application No. 63/080,364 filed Sep. 18, 2020.

BACKGROUND

The present invention relates to chairs, such as task and side office chairs, and more particularly, to an office chair that can be reclined.

Office chairs are known to include a seat, a reclinable backrest, and a mechanism that enables synchronous movement of the seat with the backrest as the backrest is reclined from a generally upright position or returned to the upright position from a reclined position. Recline tension provided by the chair may be automatically set as a function of a weight applied to the chair by the occupant seated in the chair. Thus, when a person is sitting with good posture, and at their healthiest position for maximum core strength, the recline tension is set in balance with the occupant's weight. This automatic weight-sensing feature eliminates the need to manually adjust tension each time a different user sits in the chair. Accordingly, the chair may be automatically tensioned correctly for each occupant.

An occupant of a chair may assume a sitting position with a relatively poor posture (i.e., may be slid forward in the seat in a relatively slouched position). This is generally considered an unhealthy sitting position. A problem in particular with a slouched seating position in a reclinable chair that automatically adjusts recline tension based on occupant weight is that the automatically adjusted recline tension necessarily applies a relatively high amount of pressure on the lower back when the occupant attempts to recline the chair. This provides risk for injury.

The above referenced weight sensing chairs typically use some form of a parallelogram, or four-bar linkage, to raise and lower the seat. Thus, as the backrest is caused to be moved to a reclined position, the front and rear of the seat may be caused to move upward. However, this results in a further problem in that lifting of the front of the seat may impinge upon the underside of the occupant's knee and restrict blood flow to the legs of the occupant to some extent.

Accordingly, a self-tensioning reclinable office chair that addresses at least some of the above referenced problems is desired.

SUMMARY

According to an embodiment, a chair is provided having a seat base, a backrest interconnected to the seat base via a hinge connection and movable relative to the seat base about a backrest pivot axis between a normal non-reclined position and a reclined position, and a seat supported on the seat base and having a rear portion adjacent the backrest and a front portion defining a front edge of the seat. The rear portion of the seat is interconnected to the backrest via a hinge connection such that as the backrest is pivoted to the reclined position, the rear portion of the seat pivots relative to the backrest of the seat and is elevated. The front portion of the seat is interconnected to the seat base via a hinge connection such that the seat is movable about a seat front pivot axis and such that as the backrest is pivoted to the reclined position and the rear portion of the seat is elevated, the seat pivots

about the seat front pivot axis thereby causing the front edge of the front portion of the seat to be lowered.

The chair may include a tensioning spring, a plunger for engaging the tensioning spring, and a front support bar that interconnects to the plunger and defines the seat front axis pivot axis about which the seat pivots. The tensioning spring may be mounted on the seat base beneath the seat such that a rear end of the tensioning spring is mounted to the seat base in a stationary position relative to the seat base. The front support bar extends within at least one slot formed by the seat base such that, as the backrest is pivoted to the reclined position, the rear portion of the seat is elevated, and the front portion of the seat is lowered, the front support bar moves to a rearward location within the at least one slot causing the plunger to compress the at least one tensioning spring.

According to an embodiment, recline tension provided by the chair is a function of a force required to compress the at least one tensioning spring mounted below the seat, a weight applied to the seat by a seat occupant, and a location of the weight applied to the seat relative to front and rear portions of the seat. Accordingly, as the weight is applied toward the front portion of the seat (such as by an occupant in a slouched seated position), the recline tension is reduced and, as the weight is applied toward the rear portion of the seat (such as by an occupant seated in an upright position with good posture), recline tension is increased.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the embodiments disclosed herein should become apparent from the following description when taken in conjunction with the accompanying drawings.

FIG. **1** is a side elevational view of a chair with an occupant seated therein with good upright posture according to an embodiment.

FIG. **2** is a side elevational view of a chair with an occupant seated therein with poor slouched posture according to an embodiment.

FIG. **3** is a side elevational view of a chair according to an embodiment.

FIG. **4** is a schematic view of a sliding-block linkage according to an embodiment.

FIG. **5** is a schematic view of a four-bar linkage according to the prior art.

FIGS. **6**A-**6**D are plan and side elevational views of an office side chair in upright and reclined positions according to an embodiment.

FIGS. **7**A-**7**D are plan and side elevational views of an office side chair in upright and reclined positions and schematically showing operation of the sliding block linkage according to an embodiment.

FIGS. **8**A-**8**B are cross-sectional views of an office side chair in upright and reclined positions according to an embodiment.

FIGS. **9**A-**9**C are perspective views of the seat portion of the side chair with seat covering applied and with the seat covering removed when the side chair is in upright and reclined positions according to an embodiment.

FIGS. **10**A-**10**D are plan and side elevational views of an office task chair in upright and reclined positions according to an embodiment.

FIGS. **11**A-**11**D are plan and side elevational views of an office task chair in upright and reclined positions and schematically showing operation of the sliding block linkage according to an embodiment.

FIGS. **12**A-**12**B are cross-sectional views of an office task chair in upright and reclined positions according to an embodiment.

FIGS. **13**A-**13**C are perspective views of the seat portion of the task chair with seat covering applied and with the seat covering removed when the task chair is in upright and reclined positions according to an embodiment.

DETAILED DESCRIPTION

For simplicity and illustrative purposes, the principles of the embodiments are described by referring mainly to examples thereof. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the embodiments. It will be apparent however, to one of ordinary skill in the art, that the embodiments may be practiced without limitation to these specific details. In some instances, well known methods and structures have not been described in detail so as not to unnecessarily obscure the embodiments.

A chair **10**, which may be a task office chair, is shown in FIGS. **1** and **2**. The chair **10** includes a seat **12** and a backrest **14**. In addition, for this embodiment, the chair **10** includes armrests **16** and support structure **18** including a central support post **20** and four lower legs **22** each having a wheel **24**.

The chair **10** can be positioned in an upright position (as shown in dark grey in FIGS. **1** and **2**) and a reclined position (as shown in light grey in FIGS. **1** and **2**). This can be accomplished by the seated occupant leaning backward against the backrest **14** of the chair **10** to exert a force on the backrest **14** that is sufficient to cause the backrest **14** to pivot in a rearward direction. The recline motion provided by chair **10** is capable of being started with ease and can stop softly for every sized person and can provide fluidic, responsive movement.

In FIG. **1**, the occupant **26** of the chair is seated upright with good posture in the chair **10**, and in FIG. **2**, the occupant **26** is shown slouched within the chair in relatively poor posture. Accordingly, as shown in FIGS. **1** and **2** with the designation "KG", the weight (i.e., center of gravity) of the occupant **26** applied to the chair **10** is applied to the rear portion **28** of the seat **12** in FIG. **1**, whereas the weight (i.e., center of gravity) of the occupant **26** is centered and applied on the front portion **30** of the seat **12** in FIG. **2**.

According to an embodiment, the chair **10** is configured to provide synchronous-tilting that not only is able to account for the occupant's weight applied to the seat **12**, but also able to account for the occupant' posture in the chair **10** to automatically adjust recline tension. Here, recline tension refers to the amount of force required to be applied to the backrest by the occupant of the chair to cause the backrest to recline. Recline tension must be sufficiently strong so as to prevent unwanted recline movement by an upright seated occupant.

By way of example, for a given occupant of a given weight, recline tension is automatically set at an appropriate level (i.e., a level that prevents unintended reclining, but that is not too strong as to cause injury to an occupant attempting to recline the chair) based on occupant weight when the occupant has good upright seating posture as shown in FIG. **1**. This is accomplished by a synchronous-tilt configuration that takes into account the weight of the occupant and that the weight of the occupant is being applied essentially to the rear portion **28** of the seat **12**. However, if the same occupant (i.e., the same weight is being applied to the seat) assumes a slouched position on the chair **10** as shown in FIG. **2** and the weight of the occupant is shifted and applied to the front portion **30** of the seat **12**, recline tension is automatically reduced by chair **10**. For instance, see arrow **32** in FIG. **1** which shows that the reline tension is relatively high for the occupant seated with good posture, and see the arrow **34** in FIG. **2** which shows that recline tension is relatively less when the same occupant (i.e., of the same weight) is seated with poor posture.

Thus, when the occupant **26** is sitting with good posture, at a healthy position for maximum core strength, the recline tension provided by the chair **10** is automatically set to appropriately balance recline tension with occupant weight. This weight-sensing feature does not require manual recline tension adjustment and is automatically tensioned correctly for each user.

In comparison, when the occupant **26** is sitting with poor posture (i.e., slid forward in the seat and slouched), the occupant **26** is considered to be at a relatively unhealthy sitting position. If recline tension remains the same for the same occupant seated as shown in both FIGS. **1** and **2**, too high an amount of pressure will be exerted on the lower back of the occupant in FIG. **2** when the occupant attempts to recline the chair. Thus, according to an embodiment, the amount of recline tension provided by the chair **10** automatically decreases as the occupant's weight is shifted forward on the seat **12**. This reduces pressure applied to the occupant's lower back upon recline and thereby reduces risk of injury.

Accordingly, the chair **10** provides seating that is healthy even when users or occupants slouch throughout the day. In addition, the above referenced feature results in providing the occupant with subtle feedback to which the occupant can react. For instance, as recline tension drops, the occupant's reaction is typically to scoot back in the seat thereby promoting and creating a more upright and healthy posture.

Further, the motion of the seat **12** when the backrest **14** is reclined, relieves pressure under the legs of the occupant behind his/her knees to prevent any restriction of blood flow to the legs. For instance, as shown in FIG. **3**, when the chair **10** is an upright, normal, or non-reclined position (as shown in dark grey in FIG. **3**), the front edge **36** of the seat **12** is higher in elevation then when the chair **10** is in a reclined position (as shown in light grey in FIG. **3**). Thus, this automatic drop in elevation of the front edge **36** of the seat **12** during recline, relieves pressure under the legs of the occupant supported on the front edge **36**.

According to an embodiment, the recline tension of the chair **10** is controlled by the amount of weight being applied to the seat **12** and where on the seat **12** the weight is being applied (i.e., toward the rear or front of the seat **12**) along with a force provided by a helper or tensioning spring **38**. For instance, as shown in FIG. **4**, when the weight is applied over the rear portion of the seat **12**, recline tension is relatively high (see arrow **40**). In contrast, when the same weight is applied over the center of the seat **12**, recline tension becomes relatively less (see arrow **42**), and when the same weight is applied over the front portion of the seat **12**, recline tension is further reduced (see arrow **44**).

In comparison, weight sensing chairs using some form of a parallelogram, or four-bar linkage **46**, to raise and lower the seat is shown in FIG. **5**. When the weight of the occupant is centered over the rear portion of the seat, the center of the seat, or the front portion of the seat, reline tension (see arrows **48**, **50** and **52**) remains the same for the same occupant weight. Also, the front edge of the seat in FIG. **5** is raised when the backrest is reclined and thereby undesirably exerts pressure under the legs of the occupant which can restrict blood flow to the legs of the occupant.

A sliding-block linkage **54** according to an embodiment is shown in FIG. **4**. The sliding block linkage **54** includes a front pivot point or axis **56** that remains fixed in height from the floor on which the chair **10** is supported. Accordingly, the seat front edge **36** (i.e., the part of the seat at or extending forward of the front pivot point **56**) is not lifted or elevated during incline. The front edge **36** of the seat **12** forward of the front pivot point **56** lowers or drops in elevation when the backrest **14** is reclined and thereby automatically relieves pressure behind the knees of the occupant.

As shown in FIG. **4**, as the backrest **14** is rotated rearward (see arrow **58**), the angle of the seat **12** changes (i.e., it tilts about the front pivot point or axis **56**). Thus, the seat **12** lifts in the rear and drops in the front. In addition, the further the occupant's weight (i.e., center of gravity) is located rearward on the seat **12**, the higher the amount of recline tension will be automatically generated by the chair **10** to balance the backrest **14**.

An embodiment of a side office chair **100** is shown in FIGS. **6**A-**9**C. As best shown in FIG. **6**A, chair **100** includes a seat **102**, a backrest **104**, and four legs **106**, one at each corner of the seat **102**. In addition, as best shown in FIGS. **6**B and **6**D, the seat **102** includes an upper seat section **110** providing a seating surface **108** and a lower seat section or seat base **112**.

FIGS. **6**A and **6**B show the chair **100** in an upright, normal, non-reclined position. In contrast, FIGS. **6**C and **6**D show the chair **100** in a reclined position. The legs **106** and the seat base **112** remain stationary regardless of the chair **100** being in the non-reclined or reclined position. As best shown in FIG. **6**B, in the recline position, the backrest **104** pivots rearward and the upper seat section **110** moves such that the rear of the upper seat section **110** is lifted upward and the front edge **114** of the upper seat section drops slightly in elevation.

FIGS. **7**A-**7**D show the synchronous-tilt mechanism, arrangement, or configuration **116** that enables the chair **100** to recline as discussed above. FIGS. **7**A and **7**B show the chair **100** in the non-reclined position, and FIGS. **7**C and **7**D show the chair **100** in the reclined position.

The mechanism **116** includes a pair of tensioning springs **118** contained within the seat **102**. The springs **118** extend parallel to each other and in a direction from front-to-back of the chair. The rear of the springs **118** are mounted in a stationary position to the seat base **112** and the front of springs **118** interconnect to a bar **120** or the like extending in front of and perpendicular to the springs **118**. A tensioning screw **122** is connected to the bar **120** and permits some manual fine adjustment to the amount of recline tension provided by the mechanism **116**.

The mechanism **116** defines a seat front pivot axis **124** about which the upper seat section **110** pivots relative to the stationary seat base **112** adjacent the front of the seat **102**, a seat rear pivot axis **126** about which the rear of the upper seat section **110** pivots relative to the backrest **104**, and a stationary backrest pivot axis **128** about which the backrest **104** pivots.

The bar **120** can define the seat front pivot axis **122** and hinge connection used to connect the upper seat section **110** to the seat base **112**. The opposite ends of the bar **120** can extend within relatively short travel slots **130**. Accordingly, as shown in FIG. **7**B, the seat front pivot axis **124** is located forward within the travel slot **130** when the chair **100** is in the normal, non-reclined position, and as shown in FIG. **7**D, the seat front pivot axis **124** is located rearward in the travel slot **130** when the chair **100** is in the recline position. With this mechanism or arrangement **116**, the recline tension automatically increases when occupant weight increases and reduces when occupant weight decreases. In addition, the recline tension automatically reduces when an occupant slouches forward in the chair **100** such that occupant's weight (i.e., center of gravity) is centered over a forward part of the seat **102** as discussed above.

FIGS. **8**A and **8**B show a cross-section of the chair **100** in a normal, non-reclined position and in a reclined position. The springs **118** are acted upon by a plunger **132** interconnected to the bar **120**. When the chair **100** is in the non-reclined position of the chair **100** (see FIG. **8**A), the plunger **132** presses against the springs **118**, and when the chair **100** is in the reclined position (see FIG. **8**B), the plunger **132** is forced further toward the springs **118** to further compress the springs **118**. This force combined with the occupant's weight and occupant's position on the seat defines the sets tension. As the backrest **104** is pivoted rearward about the stationary backrest pivot axis **128**, the rear of the upper seat section **110** becomes elevated as is the seat rear pivot axis **128** and the springs **118** become compressed. In addition, the front edge **114** of the upper seat section **110** is lowered as the upper seat section **110** pivots about the front seat pivot axis **124**. The force of the springs **118** position the chair **100** in the normal, non-reclined position when there is no occupant in the chair or when the occupant no longer leans rearward in the chair.

FIG. **9**A shows the upper seat section **110** in the non-reclined position. The upper seat section **110** provides an upper covering for the seat **102** and moves as discussed above. FIG. **9**B shows the mechanism **116** with the upper seat section **110** removed and with the chair in the normal, non-reclined position. FIG. **9**C shows the mechanism **116** with the upper seat section **110** removed and with the chair **100** in the reclined position. By comparing FIGS. **9**B and **9**C, it is shown that the backrest **104** pivots about the stationary backrest pivot axis **128** and that the rear of the upper seat section **110** is connected to and pivots relative to the backrest **104** about the seat rear pivot axis **126** and is thereby elevated when the chair **100** is reclined. In addition, it is shown that the seat front pivot axis **124** travels rearward in the travel slot **130** during chair recline, but remains at about the same height above the floor. Thus, the upper seat section **110** pivots about the seat front pivot axis **124** and therefore the front edge **114** of the upper seat section **110** drops in elevation during chair recline. Also, due to the rearward movement of the seat front pivot axis **124**, the springs **118** (which are mounted in a stationary position to the seat base **112**) become further compressed as the chair is reclined and provides a force in an opposite direction that urges the seat front pivot axis toward the front of the travel slot **130**.

An embodiment of a task office chair **200** is shown in FIGS. **10**A-**13**C. As best shown in FIG. **10**A, chair **200** includes a seat **202**, a backrest **204**, armrests **206**, a central support post **208** that extends to at least four legs **210** having wheels **212**. In addition, as best shown in FIGS. **10**B and **10**D, a seat support plate or seat base **214** is connected to the upper end of the support post **208**.

FIGS. **10**A and **10**B show the chair **200** in an upright, normal, non-reclined position. In contrast, FIGS. **10**C and **10**D show the chair **200** in a reclined position in which the backrest **204** is pivoted rearward and the rear of the seat **202** elevates while front edge **216** of the seat **202** drops slightly in elevation.

FIGS. **11**A-**11**D show the synchronous-tilt mechanism, arrangement, or configuration **218** that enables the chair **200** to recline as discussed above. FIGS. **11**A and **11**B show the chair **200** in the non-reclined position, and FIGS. **11**C and **11**D show the chair **200** in the reclined position.

As shown in FIGS. **12**A and **12**B, the mechanism **218** includes a pair of tensioning springs **220** contained on the seat base **214**. The springs **220** extend parallel to each other and in a direction from front-to-back of the chair **200**. The rear of the springs **220** are mounted in a stationary position on the seat base **214** and the front of the springs **220** interconnect via a plunger **224** to a bar **222** or the like extending in front of and perpendicular to the springs **220**. A tensioning screw **234** can be connected to the bar **222** to permit some manual fine adjustment to the amount of recline tension provided by the mechanism **218**.

The mechanism **218** defines a seat front pivot axis **226** about which the seat **102** pivots adjacent the front of the seat **102**, a seat rear pivot axis **228** about which the rear of the seat **102** pivots relative to the backrest **204**, and a stationary backrest pivot axis **230** about which the backrest **204** pivots.

The bar **222** can define the seat front pivot axis **226** and provide a hinged connection. The ends of the bar **222** can extend within a relatively short stationary travel slots **132**. Accordingly, as shown in FIG. **11**B, the seat front pivot axis **226** is located forward within the travel slots **232** when the chair is in the normal, non-reclined position, and as shown in FIG. **11**D, the seat front pivot axis **226** is located rearward in the travel slots **232** when the chair **200** is in the recline position. With this mechanism **218**, the recline tension automatically increases when occupant weight increases and reduces when occupant weight decreases. In addition, the recline tension automatically reduces when an occupant slouches forward in the chair **200** such that occupant's weight is centered over a forward part of the seat **202** as discussed above.

FIGS. **12**A and **12**B show a cross-section of the chair **200** in a normal, non-reclined position and in a reclined position. The springs **220** are acted upon by the plunger **224** that is interconnected to the bar **222**. When the chair **200** is in the non-reclined position (see FIG. **12**A), the plunger **224** lightly press against the springs **220**, and when the chair **200** is in the reclined position (see FIG. **12**B), the plunger **224** is forced further toward the springs **220** to compress the springs **220**. The force generated by the springs **220** combined with the occupant's weight and occupant's position on the seat **102** automatically adjusts the recline tension. As the backrest **204** is pivoted rearward about the stationary backrest pivot axis **230**, the rear of the seat **202** is elevated as is the seat rear pivot axis **228** and the springs **220** become compressed. In addition, the front edge **216** of the seat **202** is lowered as the seat **202** pivots about the front seat pivot axis **226**. The force of the springs **220** position the chair in the normal, non-reclined position when there is no chair occupant or the occupant ceases to lean rearward in the chair.

FIG. **13**A shows a top of the seat **202** in the non-reclined position. FIG. **13**B shows the mechanism **218** beneath the seat **202** and with the chair **200** in the normal, non-reclined position. FIG. **13**C shows the mechanism **218** beneath the seat **202** and with the chair **200** in the reclined position. By comparing FIGS. **13**B and **13**C, it is shown that the backrest **204** pivots about the stationary backrest pivot axis **230** and that the rear of the seat **202** is connected to and pivots relative to the backrest **204** about the seat rear pivot axis **228** and is thereby elevated when the backrest **204** is reclined. In addition, it is shown that the seat front pivot axis **226** travels rearward in the travel slots **232** during chair recline, but remains at about the same height above the floor. Thus, the seat **202** pivots relative to the seat front pivot axis **226** and therefore the front edge **216** of the seat **202** drops in elevation during chair recline. Also, due to the rearward movement of the seat front pivot axis **226**, the springs **220** (which are mounted in a stationary position to the seat base **214**) become compressed as the chair **200** is reclined and provides a force in an opposite direction that urges the seat front pivot axis **226** toward the front of the travel slots **232**.

The task chair **200** may be provided with additional features. A handle underneath the seat may be provided to enable the seat to be slid forward for manual seat depth adjustment. Thus, as needed by the end user, the seat can be positioned closer to or further away from the backrest. In addition, a further handle located underneath the seat may adjust the chair height, (i.e., to effectively increase or decrease the length of the support post). These handles may be on opposite sides of the seat underneath the seat. Further, the arm rests may be adjustable so that they can be raised and lowered in height via a trigger under the arms of the arm rests.

The various components described above may be made of metallic, non-metallic, wooden, plastic, resins, composite, fabric or like materials. The above description illustrates embodiments of how aspects of the present invention may be implemented, and are presented to illustrate the flexibility and advantages of particular embodiments as defined by the following claims, and should not be deemed to be the only embodiments. One of ordinary skill in the art will appreciate that based on the above disclosure and the following claims, other arrangements, embodiments, implementations, and equivalents may be employed without departing from the scope hereof as defined by the claims.

Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of the present invention. The benefits, advantages, solutions to problems, and any element(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential features or elements of any or all the claims.

We claim:

1. A chair, comprising:

a seat base;

a backrest interconnected to said seat base via a hinge connection and movable relative to said seat base about a backrest pivot axis between a normal non-reclined position and a reclined position;

a seat supported on said seat base and having a rear portion adjacent said backrest and a front portion defining a front edge of said seat;

said rear portion of said seat being interconnected to said backrest via a hinge connection such that as said backrest is pivoted to the reclined position, said rear portion pivots relative to said backrest about a seat rear pivot axis and is elevated;

said front portion of said seat being interconnected to said seat base via a hinge connection such that said seat is movable about a seat front pivot axis and such that as said backrest is pivoted to the reclined position and said rear portion of said seat is elevated, said seat pivots about said seat front pivot axis causing said front edge of said front portion of said seat to be lowered; and

at least one tensioning spring, a plunger for engaging said at least one tensioning spring, and a front support bar that interconnects to said plunger and defines said seat front axis pivot axis.

2. The chair according to claim 1, wherein said at least one tensioning spring is mounted on said seat base beneath said seat such that a rear end of said tensioning spring is mounted to said seat base in a stationary position relative to said seat base.

3. The chair according to claim 2, wherein said front support bar extends within at least one slot formed by said seat base such that, as said backrest is pivoted to the reclined position and said rear portion of said seat is raised and said front portion of said seat is lowered, said front support bar moves to a rearward location within said at least one slot causing said plunger to compress said at least one tensioning spring.

4. The chair according to claim 3, wherein, when said backrest is pivoted to the normal non-reclined position, said rear portion of said seat is lowered, said front portion of said seat is raised, said front support bar moves to a forward location within said at least one slot, and said tensioning spring expands.

5. The chair according to claim 4, wherein said slot extends substantially horizontally such that said seat front pivot axis remains at a substantially constant elevation when said backrest is in said normal non-reclined position and said reclined position.

6. The chair according to claim 5, wherein said seat rear pivot axis raises in elevation when said backrest is pivoted from said normal non-reclined position to said reclined position.

7. The chair according to claim 6, wherein recline tension provided by said chair is a function of a force required to compress said at least one tensioning spring, a weight applied to said seat by a seat occupant, and a location of said weight applied to said seat relative to said front portion and rear portion of said seat, such that, as said weight is applied toward said front portion of said seat, said recline tension is reduced and, as said weight is applied toward said rear portion of said seat, said recline tension is increased.

8. The chair according to claim 1, wherein said at least one tensioning spring includes a pair of tensioning springs extending adjacent and parallel to each other.

9. The chair according to claim 1, further comprising a set of legs connected to said seat base for supporting said seat base above a floor surface.

10. The chair according to claim 1, further comprising a central support post connected to said seat base for supporting said seat base.

11. The chair according to claim 1, further comprising a pair of armrests extending from said backrest.

12. A synchronous-tilt reclining office chair, comprising:

a seat;

a backrest interconnected to said seat; and

a synchronous-tilt mechanism that controls synchronous movement of said backrest and said seat between a normal non-reclined position and a reclined position such that recline tension is a function of a force required to compress at least one tensioning spring mounted below said seat, a weight applied to said seat by a seat occupant, and a location of said weight applied to said seat relative to front and rear portions of said seat, whereby, as said weight is applied toward said front portion of said seat, said recline tension is reduced and, as said weight is applied toward said rear portion of said seat, said recline tension is increased;

wherein the synchronous-tilt mechanism includes an arrangement comprising said backrest being interconnected to a seat base and movable relative to said seat base about a backrest pivot axis between a normal non-reclined position and a reclined position, said rear portion of said seat being interconnected to said backrest such that as said backrest is pivoted to the reclined position, said rear portion of said seat is elevated, and said front portion of said seat being interconnected to said seat base such that said seat is movable about a seat front pivot axis and such that as said backrest is pivoted to the reclined position and said rear portion of said seat is raised, said seat pivots about said seat front pivot axis and causes a front edge of said front portion of said seat to be lowered;

wherein said at least one tensioning spring is mounted on said seat base beneath said seat such that a rear end of said at least one tensioning spring is mounted to said seat base in a stationary position relative to said seat base; and

wherein the synchronous-tilt mechanism includes a plunger for engaging said at least one tensioning spring and a front support bar that interconnects to said plunger and defines said seat front axis pivot axis.

13. The synchronous-tilt reclining office chair according to claim 12, wherein said front support bar extends within at least one slot formed by said seat base such that, as said backrest is pivoted to the reclined position and said rear portion of said seat is raised and said front portion of said seat is lowered, said front support bar moves to a rearward location within said at least one slot causing said plunger to compress said at least one tensioning spring, and wherein, when said backrest is pivoted to the normal non-reclined position, said rear portion of said seat is lowered, said front portion of said seat is raised, said front support bar moves to a forward location within said at least one slot, and said tensioning spring expands.

14. The synchronous-tilt reclining office chair according to claim 13, wherein said slot extends substantially horizontally such that said seat front pivot axis remains at a substantially constant elevation when said backrest is in said normal non-reclined position and said reclined position.

* * * * *